EVALUATION OF TOTAL WHITE BLOOD CELL COUNT AND NEUTROPHIL PERCENTAGE IN ASSESSING THE SEVERITY OF ACUTE APPENDICITIS AT KENYATTA NATIONAL HOSPITAL.

A dissertation submitted in part fulfillment of the requirements for the award of Master of Medicine in General Surgery of the University of Nairobi.

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Declaration

I declare that this dissertation is my own original work and has not been presented for a degree or any other award in any other university.

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Abbreviations

A.A: Acute appendicitis

AUC: Area under the curve

CRP: C-reactive proteins

LR: Likelihood ratio

KNH: Kenyatta National Hospital

NP: Neutrophil Percentage

NPV: Negative predictive Value

PPV: Positive predictive value

RIF: Right iliac fossa.

ROC: Receiver operating Characteristic curves

SPSS: Statistical Package for the Social Sciences

TCL: Total leukocyte count.

WBC: White Blood Cell

Abstract

Introduction: Appendicitis is one of the most common causes of abdominal pain and indication for emergency abdominal surgery world over. History and physical examination remain the cornerstones of good clinical practice in patients presenting with acute abdominal pain localized in the right lower abdominal quadrant. Outcome of acute appendicitis is influenced by its severity. Previous studies done to determine the value of white cell count and NP in predicting severity of acute appendicitis had varied outcomes. This cross sectional study aimed to determine the value of preoperative evaluation of white blood cell (WBC) count and neutrophil percentage (NP) in predicting severity of acute appendicitis at Kenyatta National Hospital.

Objective: To determine the value of WBC count and NP in assessing severity of acute appendicitis

Study design: Cross sectional study

Study site: Kenyatta National hospital accident and emergency unit, general and paediatric surgical wards and operating theatres.

Methodology: Ethical approval was sought and granted from KNH\UON ERC. Data was collected from July to October 2014. We enrolled 119 patients who presented with features of acute appendicitis. Data including history, physical examination, total blood count, operative findings and histopathology, were obtained. One hundred and fifteen patients were analyzed. Four patients had other surgical diagnosis and appendicectomy was not performed. Patients were subdivided according to surgical and histological finding into: G0 for normal appendix n=13, G1 for acute appendicitis n=56, G2 for gangrenous acute appendicitis n=12, G3 for perforation n=10, G4 for perforated appendicitis with regional abscess n=24. Dependent variables were WBC count and NP. Independent variable was grade of appendicitis.

Data analysis: using SPSS (version 17.0) software diagnostic performances of WBC and NP were analyzed. Receiver operating characteristic (ROC) curves were drawn and comparison of mean values of leukocytes and neutrophils between different degrees of appendicitis were performed using ANOVA.

Results: WBCs and neutrophils counts were significantly higher in patients with inflamed and perforated appendicitis than normal appendix. In normal versus simple appendicitis the cutoff of WBCs count and NP was 9.64 $X10^3$ ml and 71.85%respectively. At these cut offs the sensitivity of 75.00 %, 66.07 (52.19 – 78.18) specificity of 30.77%, and 46.15; PPV of

82.35 and 84.78; NPV of 22.22% and 26.09; [LR(+)] of 1.08 and 1.29;and LR(−) of 0.81and 0.66respectively.

At these cutoff points, AUC (95% CI) for WBC count and NP was 0.649and 0.648 respectively.

The same parameters were used to discriminate normal from perforated appendicitis with cut-off values in WBCs and NP at 10.30 $X10^3$and 77.50% respectively. At these cutoff points, AUC (95% CI) for WBCs and NP were 0.796 and 0.777. WBCs and NP sensitivity were82.35 %,72.97% ;specificity38.46 %,69.23%,; PPV 77.78% and 87.10; NPV45.45 % and 47.37% ;LR(+)1.34 and 2.37 and LR(−)0.46 and 0.39.The predictive value for both WBC and NP for acute appendicitis was noted to increase with higher grades of appendicitis.

Conclusion: Leukocyte and neutrophils counts alone cannot be used as diagnostic criteria for acute appendicitis because of its low sensitivity and specificity and must be correlated with clinical data for decision making. WBCs and neutrophils counts do not reliably indicate disease severity; the low sensitivity, specificity and AUC of these tests prove that they are insufficient to achieve reliable rule-out effect. This applies also in the ability of these two parameters to discriminate inflamed from perforated appendicitis.

Introduction

Acute Appendicitis (A.A) was first described by Reginald Fitz in 1886 as the cause of right iliac fossa pain[1].Appendicitis is one of the most common indications for emergency abdominal operations worldwide. Appendicitis progresses from simple inflamed appendicitis to gangrene with subsequent perforation and abscess formation which can be localized or widespread[2].

The diagnosis of appendicitis is essentially a clinical diagnosis with laboratory investigations and imaging acting as adjuncts. .

Appendicitis is graded according to disease severity score (DSS) developed by acute care surgeons. There is a stepwise risk increase in adverse outcomes with higher disease grades[3].

Management of acute appendicitis may be influence by its severity grade[4].

WBC has been shown to rise in 90% of patients with acute appendicitis and serial measurement shows progressive rise with time[5].

Studies so far done to assess the value of inflammatory markers to predict the severity of acute appendicitis have shown inconsistent results regarding the use of WBCs and NP. Some studies have reported that WBC count is correlated with the severity of appendicitis [6, 7] while other studies have found no significant correlation between WBC count and severity of acute appendicitis[8, 9].

There is currently no consensus on the use of WBC in grading of acute appendicitis. There is no study to my knowledge done in our set up to find out the correlation of WBC to severity of acute appendicitis. There is need to find an inexpensive tool to segregate simple from perforated appendicitis and appendicitis with gangrene.

This study seeks to establish the relationship between the WBC count and NP to the severity of acute appendicitis and its relevance in grading acute appendicitis.

Literature review

Appendicitis is the disease entity resulting from inflammation of the vermiform appendix[1].Simple and perforated acute appendicitis (A.A) is a spectrum rather than two separate diseases. The most commonly accepted theory of the pathogenesis of appendicitis is that it results from closed loop obstruction usually by a faecolith followed by infection[2].The appendix may undergo gangrene with subsequent perforation and abscess formation[10].

Appendicitis is the most common cause of acute abdominal pain requiring surgical treatment in both children and adults under the age of fifty. The peak incidence occurs in the second and third decades of life[11].

At Kenyatta national hospital(KNH), appendicectomy contributes16.3% of abdominal emergencies in female[12].It is the most common overall indication at 37.5% of emergency laparotomy [13].Young patients under 30 years account for 64% while the elderly over 60 years account for 1.6% of cases of acute appendicitis[14].The range at presentation is 7-55 with a median of 26 and a mean of 27.9[15].At Kijabe mission Hospital, a Kenyan Rural hospital, the range of A.A is 4-71 years with a median age of 29 years[16].The male to female ratio of A.A in Kenya is 1.2-1.8:1[16, 15].This is comparable to Nigerian and United States studies[17, 18].

The rate of perforated acute appendicitis in Kenya is 20- 22%while that of combined gangrene non-perforated and perforated appendicitis is 29.7% [13, 14, 16]. The Kenyan rate of perforated A.A is comparable to literature data[19, 20, 21, and 22].

In the West, the perforation rate had remained the same, about 20 per cent for 50 years (1936 to 1993) despite the progress in medicine[23].Improvement in health care is apparently not associated with fewer perforations[23].This finding probably indicates that most perforations in A.A occur before hospital admissions. Patients with perforated A.A have longer duration of symptoms before surgery and are more likely to be children younger than 3 years and adults older than 50 years[11].Titte et al reported an overall perforation rate of 19% against 44% in elderly patients over 60 years[24].Patients aged 65 years and older are three times more likely to present with perforated or gangrenous appendicitis than younger patients [25]. Biological features, such as response to inflammation, could differ in elderly patients, which predispose them to advanced peritonitis than younger patients [25].

Severity of acute appendicitis can be graded according to disease severity score (DSS) developed by acute care surgeons. Grade 1, inflamed; Grade 2, gangrenous; Grade 3, perforated with localized free fluid; Grade 4, perforated with a regional abscess and Grade 5, perforated with diffuse peritonitis. There is a stepwise risk increase in adverse outcomes with higher disease grades[3].

Appendicectomy is still the gold standard in the management of acute appendicitis as demonstrated by a meta-analysis comparing efficacy and safety of antibiotic therapy to appendicectomy in A.A[26].Severity of acute appendicitis may affect the mode of management as well as its outcome.

Severe A.A is the most common reason for conversion from Laparoscopic to open appendicectomy[27].

Although surgery is the primary mode of management in acute appendicitis, studies have shown that appendicular abscess can be managed by percutaneous drainage. A meta-analysis done in 2010 reported that treatment of complicated appendicitis with percutaneous drainage and antibiotics was associated with decreased complication rates and fewer repeat surgeries compared to traditional appendectomies, while both treatments featured comparable lengths of hospitalization. The study concluded that Patients with periappendiceal abscesses should be treated with percutaneous image-guided drainage[4].Intra-operative diagnosis of A.A is not reliable. Twenty nine to thirty three percent of the appendices thought to be macroscopically normal are found to have appendicitis after histological examination[28; 29].Thus almost a third of acute appendicitis would be missed on macroscopic intra-operative examination.

Perforated A.A has more morbidity compared to overall rate and simple non-perforated appendicitis. Appendicitis at KNH has combined morbidity of 19.4% with an overall rate of 12.3% and 7.6% for non-perforated appendicitis[14].Körner et al also reported complication rates significantly higher in patients with perforated than simple non perforated appendicitis[30].Patients who have complicated appendicitis may have a greater risk of developing organ space surgical site infection following laparoscopic appendicitis[31].Furthermore Perforation is the single best predictor of mortality[32].

Studies in adults have found WBC count elevated in 80%-90% of all cases[5]. There is poor diagnostic utility for the use of abnormal WBC count alone in the diagnosis of A.A with sensitivity 76% to 77%, specificity 52% to 63%, positive predictive value (PPV) 42% to 64%, and NPV 77% to 82%[33, 34, 35]. WBC count therefore is not considered in isolation but together with other history and physical findings in the diagnosis of acute appendicitis[36].

Leukocytosis is a normal physiological response of pregnancy (up to 12 500 leukocytes/mm^3) and cannot be relied upon to help confirm the diagnosis of appendicitis. White blood-cell counts as high as 25 000 leukocytes/mm^3 are not unusual in pregnant women with appendicitis[37].

Several studies have been done to correlate WBC count and neutrophil differential count with the severity of A.A with varied results. Fergusson et al reported higher WBC count among patients with complicated appendicitis compared to those with simple appendicitis and normal appendices. They concluded that the meaning of various white cell count values would be invaluable in clinical decision making with regards to the diagnosis of A.A[38].Andersson et al noted that for advanced appendicitis (defined as either histological gangrene of the appendix, perforation, or regional abscess), the WBC count and NP had higher rates of prediction for appendicitis than in simple inflamed appendicitis[39].

Beltrán et al found that WBC had a high specificity to differentiate patients with simple from perforated appendicitis. Sensitivity however was low. The study concluded that WBC depending on the time from onset of symptoms could be used to differentiate patients with and without appendicitis as well as discriminate simple from perforated appendicitis[40].

Guraya et al found persistently higher WBC count in gangrenous and perforated appendicitis compared to simple A.A. Mean count in acute appendicitis was 14.5+/-7.3x 10(9)/L, gangrenous 17+/- 3.9x10(9)/L and perforated appendicitis 17.9+/-2.1x10(9)/L .The study concluded that a high WBC with differential count was a reliable indicator of the severity of appendicitis and signified a more advanced stage[6].Sack et al found a significant correlation between WBC and severity of appendiceal inflammation[41].

Sidique et al noted that WBC and CRP tests had a higher sensitivity but low specificity in diagnosis of simple acute appendicitis and a perforated appendix.WBC had a high negative predictive value for a perforated appendix[7].Other studies elsewhere have also supported discriminatory capacity for perforated appendicitis compared with simple appendicitis[42].

Some studies have reported no correlation of WBC count and NP to severity of acute appendicitis. Keskek et al found no diagnostic value of WBC in differentiating between uncomplicated and complicated group (area under the curve = 0.55, P = 0.086).The study concluded that while WBC count was helpful in the diagnosis and exclusion of appendicitis, it had no value to differentiate advanced appendicitis[8].

Ortega-Deballon found that WBC and neutrophils did not correlate with , and even decreased in perforated cases as compared with gangrenous appendicitis[9]. Hartwig et al concluded that WBC was not useful for the diagnosis of perforation[30].

Coleman et al found no difference in severity of disease in patients with normal WBC compared to those with elevated WBC count. From this study, the proportion of gangrenous and perforated appendicitis in the patients with a normal WBC count was the same as in the patients with an elevated WBC count[43].

Whether WBC and NP may discriminate simple from perforated appendicitis in the adult and pediatric population remains uncertain. No study to the best of my knowledge has been done in our setting to find any correlation. This study therefore sought to interrogate the relationship between White blood cell count and NP with severity of A.A at KNH.

Study justification

Studies have shown that complication rates such as surgical site infection as well as mortality increases with severity grades of acute appendicitis[30, 31].Although management of acute appendicitis is primarily by appendicectomy, severity of acute appendicitis may influence its management. Patients with appendicular abscess may be managed by Computerizedtomofigurey (CT) scan guided aspiration. Conversion rates of laparoscopic appendicitis to open appendicectomy are also related to severity of appendicitis. It is therefore important to grade acute appendicitis.

In our set up there is no established criterion to predict severity of acute appendicitis.

There was need to establish a cost effective tool for predicting severe acute appendicitis especially perforated appendicitis and appendicitis with abscess. WBC count and NP are readily available and affordable in acute accident and emergency units and would have been effective tools for predicting severity of acute appendicitis.

We had no local studies that correlate WBC count to severity of acute appendicitis.

Available studies elsewhere are varied and there was no consensus on whether there is significant correlation on not. Furthermore there existed ethnic variation in WBC counts [44].

Thus there was need to carry out a local study to determine association between WBC and NP and severity of acute appendicitis.

Null hypothesis

There is no correlation between WBC count and NP and severity of acute appendicitis.

Objective

Broad objective:

To determine the value of WBC count and NP in predicting severity of acute appendicitis

Specific objectives

1. To evaluate relationship between WBC count and severity of acute appendicitis.
2. To determine the relationship between NP and severity of acute appendicitis.

3. To determine the predictive value of combined WBC and NP to severity of acute appendicitis.

Materials and Methods

Study setting

Kenyatta National Hospital Accident and emergency department, surgical wards and operating theatres.

Study design

Cross sectional study

Study population

Patients admitted to Kenyatta National Hospital presenting with acute appendicitis

Study duration

Six months

Inclusion criteria

A clinical diagnosis of acute appendicitis.

Informed consent by patients or their guardians.

Exclusion criteria

Pregnancy

Patients on steroids and other immunosuppressive medicines.

Patients with co-morbid diseases or a long-term treatment impairing the inflammatory response.

Sampling

Nonrandomized consecutive sampling

Sample size calculation[45]

$$n = \frac{NZ^2P(1-P)}{d^2(N-1) + Z^2P(1-P)}$$

n =sample size with finite population correction

Z=standard deviation for the 95th percentile 1.96

P=Prevalence 29.7%[15].

d=Degree of accuracy expressed as a proportion (0.05)

N=population size 189[15].

N=119.

Data collection

Data was collected by the principal investigator and two research assistants.

I. Research assistants

Two research assistants with a minimum qualification of M.B.Ch.B(Bachelor of Medicine and Bachelor of surgery). They were briefed on the study. They were required to maintain patient confidentiality and other ethical research standards. They were put on a monthly stipend. Their role was consenting and administering of questionnaire.

II. Recruitment of Participants

Consecutive subjects presenting with history and physical examination suggestive of appendicitis as determined by the attending surgeon were approached for study participation. Patients with Alvarado score of 5 to 10 were included in the study [46].Patients presenting with right iliac fossa pain with ultrasound or CT scan diagnosis of acute appendicitis were also included[47].

III. Patient management

Subjects with a diagnosis of appendicitis were admitted to the hospital on the surgical service as per standard of care for treatment of acute appendicitis at KNH.

The attending surgeon requested further investigation (abdominal ultrasonography or CT-scan), examination by a gynaecologist, and observation with serial clinical exams or direct surgery at his own discretion.

IV. Consenting all participants gave written informed consent for inclusion in the study

V. Administration of questionnaire

Questionnaire was administered by the principal researcher and research assistants. Study subjects were assigned unique study identification numbers for confidentiality purpose. Questionnaires were serialized to prevent compromise of the study by release of information or counterfeiting the form. Demographic information was collected for enrolled patients as was history and physical examination, laboratory test and results of appendix histopathology. Questionnaires and reference list were kept under key and lock and access to forms was limited to principal researcher and research assistant.

VI. Laboratory tests

A pregnancy test was performed on women within reproductive age group who had missed their periods, who had not had hysterectomy or bilateral tubal ligation and who were not on follow up in antenatal clinic for pregnancy. Ten milliliters of urine samples were obtained for this test, labeled with the study number and taken to KNH/UON biochemistry laboratory for pregnancy test. Pregnant women and those who decline pregnancy test were excluded from the study.

Four milliliters of venous blood samples were drawn from all subjects before antibiotic administration and taken for full blood count. The peripheral WBC total and differential counts were determined on venous blood using an automated 5-part differential Cell Dyn® 3700 coulter counter from Abbot Laboratories USA at KNH hematology laboratory.

VII. Grading of appendicitis

Intra-operative grading of acute appendicitis was witnessed by the principal researcher.

Appendix specimen was taken to KNH/UON pathology laboratory for confirmation of the diagnosis of acute appendicitis.

Grading of acute appendicitis was based on combined surgical and pathological findings as follows[48, 49, and 50].

G0. No appendicitis

G1. Simple acute appendicitis.

G2.Gangrenous acute appendicitis,

G3. Perforation with localized free fluid,

G4. Perforated with regional abscess

VIII. Data storage and protection

Forms were serialized and kept under key and lock and access to forms limited to the principal researcher. Data was backed up in a Compact disc drive also kept under key and lock.

Data analysis

All data was recorded in Microsoft Excel data sheets that was saved under password protection only accessed by personnel involved in the project.

Dependent variables were WBC count and NP. Independent variables were sex, age and severity of appendicitis. Comparison of mean values of leukocytes and neutrophils between different degrees of appendicitis was performed with ANOVA. Using receiver-operating characteristic (ROC) curve, sensitivity, specificity, NPV, PPV, and LR were calculated by correlating the preoperative WBCs and NP with disease severity grade. Statistical analysis was performed using SPSS (version 17.0) software. For comparison of 2 groups unpaired Student's "t test" was used.AUC of 1.00 indicates perfect discriminating power while area of 0.50 indicates absence of discriminating power. All results were reported with 95% confidence intervals (95% CIs). A *P* value of < 0.05 was considered statistically significant.

Results

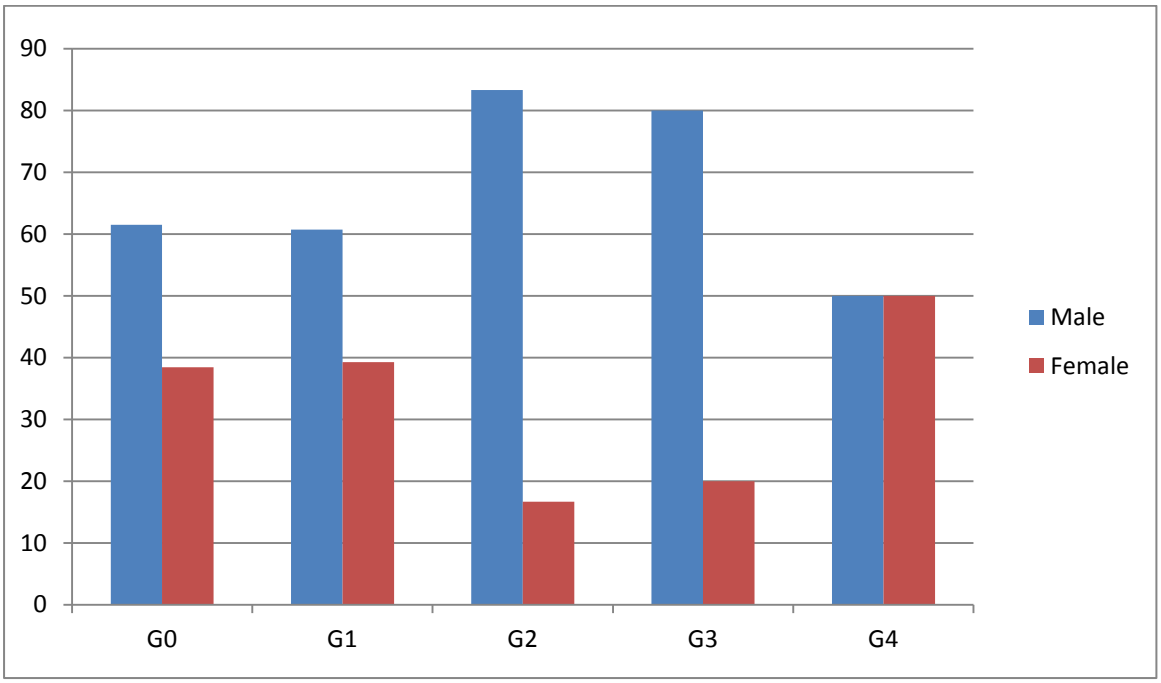
A total of 119 patients were recruited during the 4-month study period. Four of these patients were not analyzed .One had a constricting band at the ileocecal junction, one had perforated duodenal ulcer, one had perforated gastric ulcer, and one female patient was treated for urinary tract infection .Out of the 115 analyzed, there were 72 (63.03%) male and 43(36.97%) female giving a male to female ratio of 1:1.6 . The majority of patients were in the 21-30 year age bracket as shown in table 1, with a mean of 25.68 years (range, 6-64 years), median of 25 and a mode of 23 years. Appendicitis was confirmed in 102 patients while 13(11.4%) had normal appendices on histology. Leucocytosis was present in 84(73%) of patients while 81(70.4%) patients had neutrophils of 75% and above.

The mean duration of symptoms was 4 days with a mode of 4.3.There was statistically significant difference in duration of symptoms between grades of appendicitis (P=0.006).There were more males than female in all groups except in acute perforated appendicitis with a male to female ratio of 1:1. (Figure 1)

Table 1: A frequency table of age distribution of patients with acute appendicitis

Age	Frequency	Percent	Cumulative
≤10	11	9.24	9.24
11-20	26	22.69	31.93
21-30	44	37.82	69.75
31-40	23	20.17	89.75
41-50	8	7.56	97.48
≥51	3	2.52	100
Totals	115	100	

Figure 1: A figure of gender proportions against grades of appendicitis

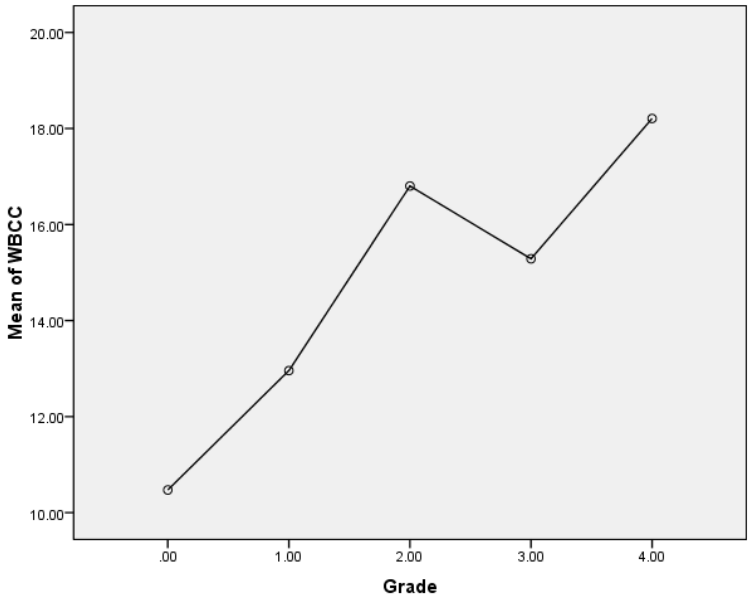


Mean onset of symptoms for male was 4.2917 and 5.225 for female. There was no sex difference in mean values of evolution of symptoms to time of surgery (P=0.233).

Mean values of inflammatory markers

There was a steady rise of WBC count from G0 to G2 with a drop in count in perforated appendicitis before rise in appendicitis with abscess as depicted in the figure 2.

Figure 2: A Figure of mean WBC against grades of appendicitis



The mean WBC count for normal appendices was 10.47±3.997, for simple appendicitis was 12.96± 4.82383 for gangrene appendicitis was 16.8025±4.82383 for perforated appendicitis was 15.28704. ±6.7655 while for perforated with abscess was 18.2083±7.20184. We found a significant difference in mean values of WBC between grades of appendicitis (P=0.0001).The mean value of WBC in perforated appendicitis was noted be lower than that of gangrene appendicitis see table 2

Table 2: Table of mean values of WBC count.

Grades of appendicitis	N	Mean	Std. Deviation	95% Confidence Interval for Mean		P Values
				Lower Bound	Upper Bound	
G0	13	10.4723	3.99688	8.0570	12.8876	
G1	56	12.9577	4.82383	11.6658	14.2495	0.046
G2	12	16.8025	5.29248	13.4398	20.1652	0.02
G3	10	15.2870	4.67655	11.9416	18.6324	0.04
G4	24	18.2083	7.20184	15.1673	21.2494	<0.001
Total	115	14.3763	5.85766	13.2942	15.4583	

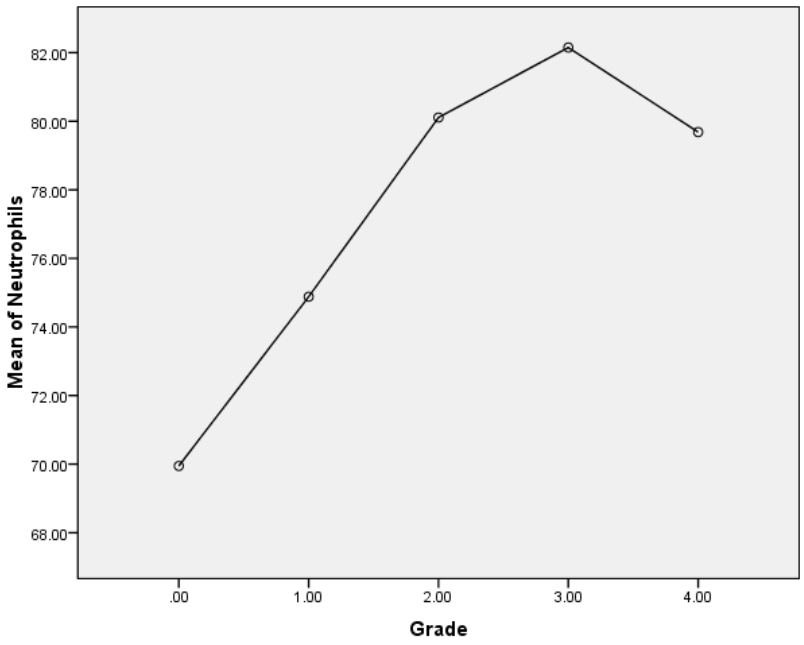
The mean value of NP in all patients was 76.5026 ±10.76426.The NP in patients with normal appendix, simple appendicitis, gangrenous appendicitis, perforated appendicitis and perforated appendicitis with gangrene were 72.2933% ±9.35502,74.5579% ± 12.50821, 81.5375 ±5.460479, 81.7182± 530939 and 79.6833 ±8.09077 respectively. There was no significant difference in mean NP between normal appendix and simple appendicitis (P=0.516). However there was significant difference in mean NP between normal appendix and higher grades of appendicitis i.e. gangrenous appendicitis, perforated appendicitis and perforated appendicitis with regional abscess. (P=0.013) as seen in table 3 and figure 3.

Table 3: A table of mean NP versus grades of appendicitis

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		P Value
Grade of Appendicitis				Lower Bound	Upper Bound	
G0	15	72.2933	9.35502	67.1127	77.474	
G1	57	74.5579	12.50821	71.239	77.8768	0.516
G2	8	81.5375	5.46049	76.9724	86.1026	0.018
G3	11	81.7182	5.30939	78.1513	85.2851	0.006
G4	24	79.6833	8.09077	76.2669	83.0998	0.013
Total	115	76.5026	10.76426	74.5141	78.4911	

This table shows the mean values of NP in various grades of acute appendicitis with P values at 95% confidence interval.

Figure 3: A figure of NPs against grades of appendicitis



This figure demonstrates the relationship between NPs. There is steady rise in mean values with increasing grades of appendicitis up to G3 (perforated appendicitis) and subsequent drop in G4 (Perforated appendicitis with abscess)

Predictive values

We evaluated the predictive value of WBC and NP in various grades of appendicitis using ROC curve.

Cut off values at which greatest sum of sensitivity and specificity was obtained for WBC and neutrophil for patients with normal appendices versus simple appendicitis was 9.64 $x10^9$\L and71.85% respectively, 10.880 $X10^9$\L and 71.85% fornormal versus all acute appendicitisrespectively and 10.30 $X10^9$\L and 77.5 % for normal versus perforated appendicitis both without and with abscess. At these values the AUC was0.719 (P=0.01) and0.704 (P=0.017), 0.649(P=0.096) and 0.648(P=0.097) and 0.796 (P=0.002) and 0.774 (P=0.004) respectively as shown in table 5, figure 4 and figure 5.

Sensitivity of WBC to predict perforated from normal appendicitis was 82.35%, NP 77.50%.sensitivities were however low at 38.46% for WBC count and 69.23% for NP.

WBC count and NP were significantly higher in patients with inflamed and perforated appendicitis than normal appendix. In normal versus simple appendicitis, the cut off values at which greatest sum of sensitivity and specificity was obtained for WBC count and NP were 9.64 $X10^3$ ml and 71.85% respectively. At these cut offs the sensitivity was 75.00 %and 66.07; specificity of 30.77% and 46.15;PPV of 82.35and 84.78 ;NPV of 22.22% and 26.09; [LR(+)] of 1.08 and 1.29 and LR(−) of 0.81 and 0.66 respectively . AUC (95% CI) for WBCs and NP was 0.649 and 0.648 respectively.

The predictive values of WBC and NP for normal versus perforated appendicitis at cut-off values of10.30 $X10^3$ and 77.50% respectively were 82.35 % and 72.97% ;specificity 38.46 % and 69.23%; PPV 77.78% and 87.10; NPV 45.45 % and 47.37% ; LR(+)1.34 and 2.37 and LR(−)0.46 and 0.39respectively.AUC (95% CI) for WBCs and NP were 0.796 and 0.777.The predictive value of both WBC and NP to diagnose acute appendicitis was noted to increase with higher grades of appendicitis. See table 4.

Table 4: Table of predictive values of WBC and NP.

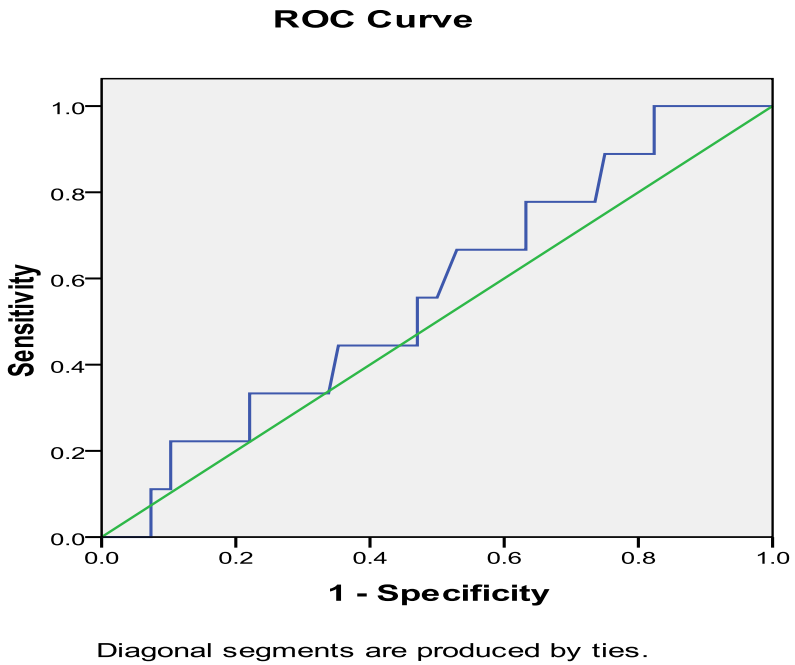
	Normal versus all AA n=115		normal versus inflamed appendix (*n*=69)		normal versus perforated appendix (*n*= 23,)	
parameters	WBC count	Neutrophil	WBC	Neutrophil	WBC	Neutrophil
Cutoff point	10.98 $X10^3$	74.45%	9.64 $X10^3$	71.85%	10.30 $X10^3$	77.50%
Sensitivity	75.24 (65.86 - 83.14)	69.52 (59.78 – 78.13)	75.00% (95%CI: 61.63 to 85.60)	66.07 (52.19 – 78.18)	82.35 %(95% CI: 65.46 to 93.19)	72.97 (55.88 – 86.19)
Specificity	55.33 (27.75– 84.68)	45.29 (35.18 - 87.11)	30.77(95%CI : 9.28 to 61.39 %)	46.15 (19.33 – 74.78)	38.46 %(95% CI: 14.00 to 68.36)	69.23(38.61 - 90.72)
PPV	96.86 (81.89 – 94.64)	93.59 (85.66 – 97.86)	82.35(95% CI: 69.12 % to 91.58 %)	84.78(71.12-93.63)	= 77.78%(95% CI: 60.84 to 89.86)	87.10(70.15 -96.29)
NPV	18.75 (7.25 – 36.45)	21.95 (10.58-37.62)	22.22%(95% CI: 6.55 to 47.64)	26.09 (10.29 – 48.41)	45.45 %(95%CI:16.92 to 76.50)	47.37(244.9 - 71.10)
LR(+)	1.40(0.83-2.34)	1.95(0.95-3.98)	1.08(95% CI: 0.73 to 1.60)	1.29 (0.76-2.20)	1.34(95% CI: 0.85 to 2.11)	2.37 (1.03 - 5.49)
LR(−)	0.54(0.27 – 1.05)	0.47(0.29 - 0.77)	0.81(95%CI: 0.32 to 2.07)	0.66(0.32 – 1.34)	0.46(95% CI: 0.17 to 1.25)	0.39 (0.21 - 0.74)
AUC	0.719 (95%CI =0.599-0.840)	0.704 (CI 95% 0.547-0.861)	0.649 0.075 CI (95%0.501-0.797)	0.648 95%CI0.479-0.0818)	0.796 95%CI 0.668-0.925)	0.777 95CI 0.16-0.939)
P Value.	0.01	0.017	0.096	0.097	0.002	0.004

The table 4 shows that sensitivity of WBC and NP in diagnosis of acute appendicitis increases with grades of acute appendicitis from 75% and 66.07% for simple acute appendicitis to 82.35% and 72.97 respectively for perforated appendicitis. Specificity for both WBC and NP however remained low.

We determined the predictive values of WBC and NP in all non-perforated versus all perforated AA.

Neither the WBC count nor the NP was able to reliably predict perforation. The sensitivity of WBC counts and NP to predict perforation was 55.56 % and 66.67 % with specificity of 50.00 % and 60.29 % respectively. The PPV of WBC count was 12.82 %and that of the NP 18.18%respectively. The NPV of WBC and NP were 89.47%and 93.18% respectively .See table 5, figure 4 and 5.

Figure 4: ROC curve for WBC to predict perforation in acute appendicitis.



NP at a cut off of 79.7% of had sensitivity of 66.7 and 60.29% to predict perforated appendicitis. The AUC was 0.685 (0.531-0.838). P=0.073).

Figure 5: ROC curve of sensitivity of NP for predicting perforation in acute appendicitis.

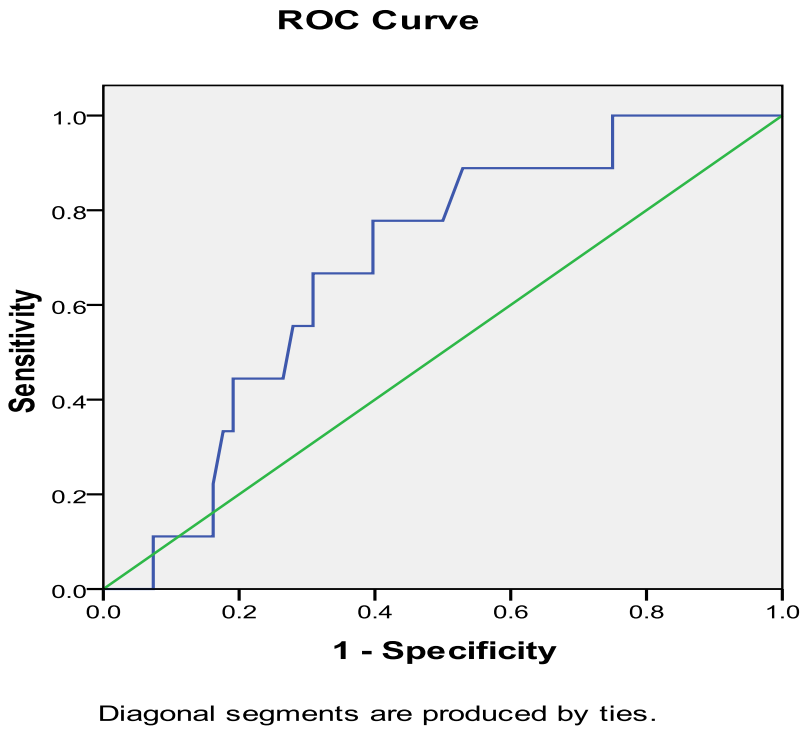


Table 5: Table of predictive values of neutophil and WBC count for non-perforated (G1, G2) appendicitis versus perforated appendicitis.

	NP	WBC count
Cut off	79.7 %	11.50
Sensitivity	66.67 %(95% CI: 30.07 % to 92.12 %)	55.56 %(95% CI: 21.40 % to 86.03 %)
Specificity	60.29 % (95% CI: 47.70 % to 71.96 %)	50.00 %(95% CI: 37.62 % to 62.38 %)
LR-	1.68(95% CI: 0.97 to 2.90)	0.89(95% CI: 0.41 to 1.92)
NL+	0.55(95% CI: 0.22 to 1.42)	1.11(95% CI: 0.59 to 2.09)
PPV	18.18 % (95% CI: 7.02 % to 35.47 %)	12.82 % (95% CI: 4.34 % to 27.44 %)
NPV	93.18 % (95% CI: 81.32 % to 98.49 %)	89.47 % (95% CI: 75.18 % to 96.99 %)
AUC	0.685 (0.531-0.838) P=0.073)	0.564(CI 95% 0.379-0.748) P=0.536

Table 6: A table of sensitivity and specificity of combined WBC and NP using or" rule.

	Sensitivity	specificity
Normal versus all appendicitis	93%	40%
Normal versus simple AA	93%	14%
Normal versus all perforated AA	94%	17%

This table shows the predictive values of combined WBC and NP in predicting severity of acute appendicitis. Sensitivity is demonstrated to substantially increase while sensitivity is very low.

Discussion

This single institution study was prospective and included consecutive patients referred by the emergency physician to the general surgeon on call for acute right iliac fossa pain. Performing the study within this selected population allows the transfer of results to this setting. The rate of histological normal appendices after appendectomy in this study was consistent with rates previously reported by other investigators in Kenya.[7, 8].In this study our male to female ratio of 1:1.67 was well within the range of reported in previous studies in Kenya and other parts of the world. [8, 11, 17, 18]

Patients younger than 30 years accounted for 69.75 % while those above the age of 50 years accounted for 2.52%of our study population. This is comparable with findings in a previous study at the same institution. [14]Most authors have reported low rates of acute appendicitis above 50 years. [14]The mean age at presentation was also within that reported in studies in Kenya and other parts of the world[15, 16].

The rate of perforated acute appendicitis was 7% above the upper limit reported by other authors at Kenyatta national hospital[13, 14, and 16]. The rates reported in western literature is about 20%[23].This could be attributed to longer time of evolution of symptoms before surgery. A Canadian study reported an average time of evolution of symptoms to surgery of 2.66 days compared to our finding of 4.365 days[51].

The proportion of patients who had intra-operative diagnosis of appendicitis with normal appendix at histology was 11.4%.This compares with the rates reported of between 12% and 18% [7, 8].

Twenty percent of patients graded intra-operatively as normal appendices returned a histological diagnosis of simple inflamed appendicitis, a finding lower than the rate reported in other literature of 29 to 30%. We concur with the recommendations of others investigators that in the absence of any other intra-abdominal diagnosis, appendicectomy should be done even if the appendix is grossly normal[30, 28, 29].

This study found no statistically significant difference in mean value of NP between histological normal appendices and simple appendicitis (P =0.516).However there was a statistically significant difference throughout other grades of appendicitis (P= 0.013).Thus the usefulness of NP would appear to increases with higher grades of appendicitis.

The WBC count in all progressive grades of appendicitis was significantly higher than that of normal appendices. Mean WBC in perforated appendicitis was noted to fall below that of gangrenous appendicitis. This finding was however not significant (P=0.49).Ortega-Deballon found a significant drop in mean values of WBC in perforated appendicitis compared to gangrenous appendicitis[9].This study concurs with previous studies that demonstrate progressively increasing WBC counts through the grades of acute appendicitis[38, 39].

Predictive value of WBC and NP for normal versus all acute appendicitis were sensitivity of 75.24% and 69.52%;specificity of 58.33 and 45.29;PPV of 94.51% and 93.59 %; NPV of 19.44 % and 21.95%LR (+) of 1.79 and 1.95;LR(−) of 0.54 and 0.47respectively.AUC for (95% CI) for WBCs and NP were 0.718 and 0.704.The sensitivity of raised NP fell within the range of 60 to 84% reported in various studies[52,53,54].

The sensitivity improved to 93 % while the specificity continued to be low at 40% when raised WBC count and raised NP was combined by the ‘or’ rule. Lau et al observed comparable results of 90.5% (sensitivity) and 58.8% (specificity) [55].

WBCs and NP predictive values for cases with normal versus simple appendicitis were ;sensitivity of 72.38% and 66.07% ;specificity 47.15% and 46.15% ;PPV 91.57 % and 84.09%; NPV 17.14 and 24.00 ; LR (+) 1.34 and 1.29 and LR (−)0.60 and0.66. AUC (95% CI) for WBCs and NP were 0.649 and 0.648.

WBC and NP for cases with normal appendices versus perforated appendicitis sensitivity were 78.79% and 72.97% , specificity 46.15 and 69.23, PPV of 75.79 % and 87.10 % , NPV, 51.27% and 47.37% ;LR(+)1.46 and 2.37 and LR(−)0.46 and 0.39 .AUC (95% CI) for WBCs and NP were 0.796 and 0.777. These results show that predictive value for both WBC and NP for acute appendicitis increases with higher grades of appendicitis. An excellent test usually has an AUC of 1.Test with AUC of 0.80-0.90 is considered good, 0.70-0.80 fair while 0.50 to 0.60 is considered fail. Other investigators have constructed ROC curves for WBC similar to our results. [30] However with AUC of 0.796 and 0.777 these tests are considered to have fair discriminative values and may not be used alone to predict severity of acute appendicitis.WBC and NP had high PPV but low sensitivity and specificity to predict acute appendicitis. Sensitivity increased with increasing grades of appendicitis. However specificity remained low.

The cut off cut-off values of WBCs and neutrophils counts for were non peforatedG1 and G2 versus perforated
11.50 and 79.7 % respectively. At these cutoff points, AUC (95% CI) for WBCs and neutrophils were 0.564, 0.685. WBCs and neutrohils sensitivity were 55.56 % and 66.67 %;specificity 50.00 % and 60.29 % ;PPV12.82 % and 18.18 %, NPV89.47 % and 93.18 % LR(+) 1.11and 0.55and LR(−)0.89 and 1.68.Sensitivities and specificities of both inflammatory markers were low in predicting perforations in acute appendicitis. However the tests had a high negative predictive value in perforated appendicitis.

WBC had both low specificity and sensitivity. This finding concurs with a study which reported no value of WBC to differentiate advanced perforated appendicitis (AUC 0.55, P=0.086) [8, 30]. Other studies have however supported discriminatory capacity of WBC for perforated appendicitis compared to simple appendicitis[40, 42]. NP had low sensitivity but high specificity to predict perforation.

Conclusion

While there is an association between Leukocyte and NP with severity of AA, these tests alone or in combination cannot be used as to predict AA because of its low sensitivity and specificity and must be correlated with clinical data for decision making. WBCs and neutrophils counts do not predictably indicate disease severity; the low sensitivity, specificity and AUC of these tests prove that they are insufficient to achieve reliable rule-out effect. This

applies also to the ability of these two parameters to discriminate perforated from inflamed but non perforated appendicitis.

Recommendations

Other studies of inflammatory markers either alone or in combination with WBC and\or NP and imaging modalities should be evaluated in our setup to predict perforated AA and AA with abscess.

TIME TABLE

ACTIVITY	FEB 2014	MARCH-JUNE 2014	JULY 2014	AUGUST 2014	SEPT 2014	OCTOBER 2014	NOVEMBER 2014
PROPOSAL							
ETHICAL APPROVA							
DATA COLLECTION							
DATA ANALYSIS							
DISSERTATION SUBMISSI							

Budget

ITEM	COST PER UNIT	TOTAL COST
Research assistant	@5,000 per month x2 assistants	60,000/=
Statistician consultation fees	15,000	15000/=
Stationery(pens, notebooks, staplers)	3,000	3,000/=
Printing	@10/= per page	5,520/=
Pregnancy test	@ 200	11,800/=
Full haemogram	@ 500 x119	63,500/=
Pathology	@600 x 119	71,400/=
Contingency fund		30,000/=
Total		290,220/=

The study was funded by the principal researcher.

Ethical considerations

This study was approval by Kenyatta National Hospital clinical and ethical committee.

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Appendix I - Consent form

This Informed Consent form is for patients of all ages hospitalized at the Kenyatta National Hospital with Acute appendicitis. We were requesting these patients to participate in this research project whose title is Evaluation of total white blood cell count and NP in assessing the severity of acute appendicitis at Kenyatta national hospital. The consenting tools were approved by the KNH\UON ethical review committee

Principal investigator: Dr. Benard Oburu Oreke

Institution: School of Medicine, Department of surgery- University of Nairobi

Supervisors: Professor George A.O. Magoha, Dr. Daniel Kiptoon, Dr. Awori Mark Nelson

This informed consent has three parts:

(i)Information sheet (to share information about the research with you)

(ii)Certificate of Consent (for signatures if you agree to take part)

(iii)Statement by the researcher

You will be given a copy of the full Informed Consent Form.

Part I: Information sheet

Introduction

I Benard Oburu Oreke a postgraduate student in University of Nairobi's School of Medicine is carrying out a study to find out relationship between white blood cell count and NP and severity of acute appendicitis.

Purpose of the research

Appendix is an out-pouching of the large gut, a normal creation. Sometimes it can get inflamed due to obstruction and infection .It may progress in severity to gangrene and perforation usually at its tail end. Abscess may form limited around it or spread in the whole abdomen .White blood cells may raise as the disease progresses. This disease is normally treated by surgical removal of the appendix which is taken for laboratory analysis to confirm the disease. My study seeks to determine the relationship between white blood cell count and

NP and degree or severity of acute appendicitis. This study is part of the requirement for me to attain postgraduate degree.

Study location

I will be carrying out this study at Kenyatta national hospital emergency unit, surgical children's wards and general surgical adult wards and operating theatres.

Type of Research Intervention

Pregnancy raises white blood cell count. We will request you to take a pregnancy test if indicated to rule out pregnancy. This will be done by requesting your\your proxy's urine sample which will be analyzed in the KNH laboratory. If the test turns positive, I will exempt you\your proxy from the study.

We request consent to draw blood from you\your proxy for white blood cell count.4mls of blood sample will be drawn from you/your proxy's peripheral vein through a needle and a syringe from your\your proxy's arm and put in a bottle containing a substance that will prevent it from clotting .The sample will be taken to the laboratory for analysis of white blood cells. The operative finding of the state of your/ your proxy's appendix will also be recorded. The appendix removed from you/your proxy at surgery will be sent to the pathologist for analysis and the outcome will also be recorded in the questionnaire.

Nature and Degree of risk

The study does not seek to introduce any drug and or agent in your/your proxy's body. Decisions on your management will be done by the attending doctor and this study will not affect in any way how the attending doctor will carry out your treatment. You\your proxy may feel slight pain or a sting when the needle is inserted to draw blood from veins for laboratory test.

Voluntary participation/right to refuse or withdraw

Your participation in this study is voluntary and declining to do so will not deny you service.

The information gained from this study may help clinicians to formulate new method of predicting severity of acute appendicitis which may have an impact on patient management.

I am requesting your participation. You will be given the opportunity to ask questions before

you decide to consent. Kindly seek clarification from me or my research assistants if there are parts of this information sheet you don't understand.

Alternative to participation

Alternative to participation is not participating.

Cost and compensation

Cost for full blood count and histology tests in this study will be catered for by the principal researcher. Other costs arising from your management at Kenyatta national hospital not related to this study like radiological, blood tests requested by your attending surgeon other than full blood count, ward charges and operative costs will be catered for by the you\your guardian.

You will not incur extra costs arising from this study. There will be no compensation or inducement for participation. During the treatment of appendicitis other tests like ultrasound and CT scan may be requested as well as drugs to treat you. Costs will also arise for surgery. This will be at the discretion of your attending clinician its costs will be covered by you.

Confidentiality

You will be requested to provide personal information and other details relating to acute appendicitis. Information provided will be kept confidential and will bear none of your names. No one except the researchers will access the information.

Your name will not appear in any document or any specimen container. The information about you will be identified by a number and only the researchers can relate the number to you as a person to protect your identity.

Sharing the results

Your information will not be shared with anyone else unless authorized by the Kenyatta National Hospital/University of Nairobi – Ethics and Research Committee (KNH/UoN-ERC). All the information that you give us will be used for this research only.

Benefits

You will not directly benefit from your participation in this study. However this study may add to knowledge in grading of severity of acute appendicitis.

Audio-visual recordings

There will be no audiovisual recording in this study.

Data uses.

I do not anticipate using any specimen or research data in this study for other studies in future.

Ethical approval

This proposal has been reviewed and approved by the KNH/UoN-ERC, the committee which ensures that research participants are protected from harm and violation of rights. It was submitted to them through the Chairman of the Department of Surgery at School of Medicine of the University of Nairobi with the approval of the three university supervisors. Who to contact

The contact information of these people is given below if you wish to contact any of them for whatever reason;

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4. Principal researcher
Dr Benard Oburu Oreke
Department of Surgery, School of Medicine, University of Nairobi
P.O. Box 19676 - 00202, Nairobi.
Mobile phone 0721989129

Part ii: Consent certificate by patient

I_____ voluntarily give consent of myself or for my proxy (Name) _____ to participate in the study being conducted by Dr Benard Oburu Oreke whose nature has been explained to me by himself/his research assistant. I understand that participation in this study is voluntary and I am free to withdraw from it at any point of the study without alteration of medical care given to me.

Signature_____

Witness_____

Person obtaining the consent_____

Statement by the witness if participant is illiterate

I have witnessed the accurate reading of the consent form to the participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness _____

Signature of witness_____

Researcher taking the consent _____

Date _____

Day/Month/Year

Part iii: Statement by the researcher

I have accurately read out the information sheet to the participant, and to the best of my ability made sure that the participant understands the following:

- Participation is voluntary and failure to participate will not deny the patient right to

optimal management

- There will be no extra cost incurred by the subject and there will be no inducement
- No agent will be introduced other than the usual management procedures.
- Personal Information and results will be kept confidential.
- Results of this study may be published to enhance scientific knowledge

I confirm that the participant was given an opportunity to ask questions about the study. Questions asked by the participant have been answered correctly and to the best of my ability.

I confirm that the individual has given voluntary informed consent.

A copy of this Informed Consent Form has been provided to the participant.

Name of researcher taking consent _____

Signature of researcher taking the consent _____

Date _____

Day/Month/Year

Appendix II
Sahili consent

Utambulisho

Mimi Benard Oburu Oreke mwanafunzi wa shahada ya uzamili ya upasuaji Katika Chuo kikuu cha Nairobi ninafanya utafiti kuhusu uhusiano wa chembe chembe nyeupe za damu na ukali wa ugonjwa wa Kidole tumbo.Uchunguzi huu ninaufanya ili kutimiza hitaji ya shahada ya uzamili ya upasuaji.

Lengo la utafiti
Appendicitis ni ugonjwa ambayo hutokana na kuziba kasha kufura kwa kidole tumbo(Appendix) ya matumbo pana ambayo huwa kawaida imo kwenye sehemu ya chini upande wakulia watumbo. Kipimo cha chembechembe nyeupe ya damu ni mojawapo ya uchunguzi ufanywao kwa wagonjwa wanaokuja hospitali wakiwa na uchungu unaodhaniwa kuwa wa appendix .Kwenye utafiti huu ,nitachunguza kiwango cha chembechembe nyeupe ya damu na kuilinganisha na makali ya ugonjwa ya Appedicitis.Ili kufanya hivyo,maswali kadhaa yanayo husiana na ugonjwa wa appendix yataulizwa na kujazwa kwenye fomu.

Sampuli ya Kibaologia

Ujauzito huongeza kiwango cha chembechembe nyeupe ya damu.Kwa ruhusa yako tutachukua sampuli ya mkojo yako/ya binti yako millilita kumi kuhakikisha kwamba wewe/binti si simjamzito. Iwapo uchunguzi utapata wewe\binti ni mjamzito,tutakuruhusu kutoshiriki kwenye uchunguzi huu.
Tunakuomba ridhaa kutwaa pia mililita nne ya damu yako/ya mtoto wako kutoka kwenye mishipa ya mkono ambayo tutaiweka kwenye chupa na kupeleka kwenye maabara ya Hospitali ya Kenyatta na Chuo Kikuu cha Nairobi kupima chembechembe nyeupe ya damu.
Twaomba ridhaa kuchukua kidole tumbo yako/mtoto na kuipeleka kwenye maabara ya pathologia ya hospitali ya Kenyatta na Chuo kikuu cha Nairobi kubaini ukali wa ugonjwa ya appendicitis.Sampuli ya kibaologia itakayotwaliwa kutoka kwako\mtoto wako haitatumika kwa njia yoyote kando na maelezo ya utafiti huu.

Siri

Nakala yote ya uchunguzi huu hayatakuwa na jina lako,ila yatapewa namabari ya uchunguzi.Hakuna mtu atakaye ruhusiwa kuona nakala hizi ila tu mchunguzi mkuu na wasaidizi wa uchunguzi.
Nakala zote zitawekwa kwa siri na hazitasambazwa ila tu kwa ruhusa ya mkurugenzi mkuu wa utafitiwa chuo kikuu cha Nairobi na hospital kuu ya Kenyatta.

Uonyeshaji ya matokeo ya utafiti

Matokeo ya uchunguzi huu huenda ya kasaidia kuongeza maarifa kuhusu kutafsiri kwa ukaliwa ugonjwa wa Appendicitis ambayo itasaidia katika matibabu .
Hamna tiba yoyote ya kawaida itatumika katika uchunguzi huu.

Hiari ya kushiriki na haki ya kukataa kushiriki au kujiondoa kwenye utafiti

Una ruhusa kutoji shirikisha kwenya uchunguzi huu na kufanya hivyo haitakunyima tiba ama usaidizi wowote kwenye hospitali.

Gharama ya Kushiriki

Gharama ya kushiriki utafiti huu utalipwa na mtafiti mkuu.Gharama yatajumlisha sampuli za damu kupima chembechembe nyeupe za damu,mkojo kupima mimba na gharama ya kupima kidole tumbo kama ina ugonjwa ya appendicitis.Kuna uchunguzi nyingine za damu kama kupima madini ya kuangalia figo na picha za ultrasound na Computerized Tomography scan ambayo huwa yaweza kufanywa kuchunguza ugonjwa wa kidole tumbo. Utafiti wangu haulengi kufanya uchunguzi nyingine.Matibabu yako yatafanywa na dactari atakayekuwa anakutibu na iwapo ataitisha uchunguzi nyingine,basi utagharamia hayo.

Madhara

Huenda ukasikia uchungu pindi utakuwa\mtoto wako atakuwa anatolewa damu ya uchunguzi kwa kutumia shindano.Hakuna dawa yoyote ama tiba yoyote kwenye utafiti huu kando na ile itakayodumishwa na daktari anayekutibu.

Nakala za kanda ya sikizi-onyeshi
Hatutanakili video ama kanda za kusikizwa kwenye uchunguzi huu.
Manufaa ya kushiriki utafiti
Hakuna manufaa yoyote kwa sasa yatakayokujia kwa kushiriki utafiti huu,ila huenda matokeo ya utafiti yakachangia katika taaluma kwa kujua ikiwa chembechembe nyeupe yaweza kutumiwa kutabiri makali ya ugonjwa wa kidole tumbo.

Idhini ya kimaadili

Utafiti huu umeruhusiwa na kitengo cha Kimaadili cha Kenyatta na Chuo kikuu ya Nairobi.Kitengo hikio uhusika na kuhakikisha kuwa utafiti wowote unaohusisha binadamu huikusudii kuhujumu afya na hadhi ya mshiriki.

Idhini ya kushiriki utafiti
Ukiridhika na kukubali kushiriki kwenye utafiti huu,tafadhali ijaze fomu ya ridhaa.

Waweza kupata maelezo kwa maswali yoyote sasa na hata baadaye kwa kupiga simu kwamta fiti mkuu ama mkuu wa idara ya upasuaji katika chuo kikuu cha Nairobi ama walimu wasimamizi wa utafiti ukitumia nambari za simu zifuatazo;

Katibu maadili ya utafiti,
Hospitali kuu ya Kenyatta na Chuo kikuu cha Nairobi.
Sanduku la Posta 20723-00202, Nairobi.
Nambari ya simu 0202726300 Ext. 44102.
Barua pepe: uonknh_erc@uonbi.ac.ke.

Walimu wasimamizi wa Chuo kikuu cha Nairobi:
1.Professor George A.O Magoha
Sanduku la Posta 19676 – 00202, Nairobi.
Nambari ya simu:0202726300

2.Daktari Dan Kiptoon,
Sanduku la Posta 19676-00202, Nairobi.
Nambari ya simu: 0202726300

3.Daktari Mark Nelson Awori,
Sanduku la Posta 19676-00202, Nairobi.
Nambari ya simu: 0202726300

4. Mtafiti: Benard Oburu Oreke,
Idara ya Upasuaji
Chuo kikuu cha Nairobi, Sanduku la Posta 2678 – 00202, Nairobi.
Simu ya rununu 0721989129

(ii) Sehemu ya pili – Idhini ya mgonjwa.

Mimi (Jina)……..kwa hiari yangu ama kwa niaba ya mgonjwa wangu (Jina la Mgonjwa .....) nimekubali kushiriki katika utafiti huu unaofanywa na Daktari Benard Oburu Oreke baada ya kupata maelezo kuhusu utafiti huu nakuyaelewa na bila masharti yoyote.

Naelewa kwamba ninauwezo wa kujiondoa kwenye utafiti huu wakati wowote bilatisho lakutopata matibabu dhabiti.

…….
Sahihi/ama alama ya kidole cha gumba katika sanduku
Tarehe…….....
Siku/Mwezi/Mwaka

Kidole cha gumba kwa Yule asiyeelewa kuandika

Jina la shahidi……
Sahihi…….
Tarehe…….
(Siku/Mwezi/Mwaka)

(iii) Sehemu ya tatu – Dhibitisho la mtafiti

Hii ni kudhihirisha kwamba mimi na wasaidizi wa uchunguzi tumemjulisha mshiriki ama msimamizi wake kuhusu utafiti huu kulingala na fomu ya maelezo na tumejibu maswali aliyouliza kwa kina .

Jina la mtafiti ama msimamizi wake……
Sahihi……..
Tarehe…….
(Siku/Mwezi/Mwaka)

Appendix III: Questionnaire

Study number_____
Age_____
Sex_____
Date of onset of symptom_____
Date of surgery _____

Symptoms

RIF pain Yes ☐ No ☐

Anorexia Yes ☐ No ☐

Nausea Yes ☐ No ☐

Loss of appetite Yes ☐ No ☐

Signs

Temperature in 0C _____

RIF tenderness Yes ☐ No ☐

Rebound tenderness Yes ☐ No ☐

Laboratory results

WBC count_____

Neutrophil %_____

Pregnancy test Positive ☐ Negative ☐

Not indicated (Give reason)_____

Alvorado Score _____

Surgical findings

G0.Normal appendix ☐

G1. Simple acute appendicitis, ☐

G2. Gangrenous acute appendicitis, ☐

G3. Perforation with localized free fluid, ☐

G4. Perforated with regional abscess ☐

Pathological finding

G0.Normal appendix without any pathologic change. ☐

G1. Acute appendicitis with intraluminal and mucosal inflammation. ☐

G2. Gangrenous appendicitis. ☐

G3. Perforated appendicitis ☐