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Epidemiologic Features of Acute Appendicitis in A Tropical African Population

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Abstract

Background: The verifiable range of existence of appendicitis in Cameroon and the enormity of etiological factors in appendicitis are unknown.

Objective: To describe the epidemiology of acute appendicitis in the northwestern region of Cameroon.

Methods: A retrospective observational population-based cohort study was conducted to evaluate the demographic features, incidence and seasonal variation of acute appendicitis using the medical database of St Elizabeth Catholic General Hospital, Shisong in the northwestern region of Cameroon from January 2006 to January 2016. We assessed confirmed histopathological specimens of appendicitis against sociodemographic data of the patients.

Results: A total of 772 out of 784 cases of appendicitis documented were confirmed histologically from the hospital records. Fifty-two percent were males and 48% were females. The appendicitis cases were made up 0.94%, 1.53%, and 2.86% of the total hospital admissions in 2006, 2007, and 2010, respectively. There has been an increasing incidence in both sexes almost in a similar pattern. The overall mean age was 28.64 ± SD 10.12 years with 6% below the age of ten and 1.5% above 60 years. The highest incidence in males and females occurred in the second and third decades, respectively. Incidences were higher during the rainy season (April to September) 68%, $P < 0.05$), with peaks from June to August, when 42.5% of all cases presented.

Conclusion: Appendicitis is relatively rare in northwest Cameroon. The rising incidence rate of the disease in both sexes in this region may be due to the change to a Western lifestyle. The elevated level of occurrence of infections and allergens from pollens during the rainy season may be responsible for greater incidence of appendicitis.

Keywords: Age distribution; Appendicitis; Incidence; Seasonal variation; Sex distribution; Trends.

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Introduction

Acute appendicitis (AA) has been generally considered to have a low incidence rate in the tropical African population and similar reports have been obtained in low socioeconomic communities of Asia and Latin America. [1-3] Globally, there is overwhelming agreement that AA is the most frequently encountered surgical abdominal emergencies.[3,4] There has been considerable report of the epidemiology of AA covering incidences, sex, age, and, with insufficient data from Cameroon. On the contrary, other reports suggested that the frequency of occurrence of AA is higher in the western countries and especially the high socioeconomic settings in the developed nations, although we are realizing a reduction in recent time. [5-8]

It is noteworthy to observe a changing trend of increasing incidence of AA in some African countries in the last few decades. [9-12] A gradual adoption of a western lifestyle, including diets have been considered to be responsible for this situation.[13] One hypothesis that hold- sway suggests that the high fiber content of diet in these group of people in the tropical Africa allows for a reduce fecal transit time and invariably responsible for a low frequency of occurrence of fecaliths in the lumen of the appendix as a causal agent for AA in people living in these parts of the world.[14-16] An alternative hypothesis suggests that appendicitis is an immunological disease which tends to be more prevalent especially in settings where housing and public health indices have improved significantly.[17-22] However, events following the Second World War such as a reduction in domestic overcrowding and a falling birth rate might have contributed to the epidemics as narrated by a study.[23] Interestingly, some authors suggest that overcrowding may play a favorable role in the prevalence of appendicitis which may express indirectly the contribution of poor hygiene in the low occurrence of appendicitis in developing countries.[8,24-27] The implication of this attendant theory suggests that for AA to occur the individual resident in the communities must be exposed to local or remote infections resulting in hypertrophy of the lymphoid follicles that abound in the wall of the appendix, consequently the hypertrophied lymphoid follicles lead to luminal obstruction.[8,24-27] This hypothesis attempts to bring to the fore reasons for higher incidence of AA in the developed countries in comparison to developing countries. In a related development, some authors widely reported that AA tends to occur more frequently in males [8,24-27]; while others have suggested a significantly higher incidence in females.[12] Nonetheless, AA occurs generally with the peak age incidence in the age range of 10 to 30 years. Others have reported seasonal variation with AA; the summer months recording higher incidences have been submitted by some authors. [5,26,28,29] The role of viral infections in the epidemiology of AA cannot be underestimated. According to Ashley which states that "there is an excess of AA during the spring implicating a high prevalence of viral infections among others during these months, but Sanda et al have suggested intense challenge to the mucosa-associated lymphoid tissue (MALT) from allergens in the dust, during the sandstorms of the spring months, in the Arabian Peninsula".[30,31]

In a related development, other authors reported that "the true incidence of appendicitis in developing countries like Cameroon is unknown due to poor medical record-keeping and unreliable population census. Estimates of population incidence of appendicitis in countries like Ghana,[32] Madagascar,[33] Central African Republic[30] and Ethiopia[31] have relied on small population counts but even then, these figures show a low incidence in comparison to countries in Western Europe and North America." Interestingly, there have not been any studies from the Cameroon which provided reports on either the population incidence of appendicitis, the epidemiology and socio-demographic of AA. St Elizabeth as a tertiary hospital has a reliable comprehensive medical record of surgical operations and pathological specimens with which the author could provide a true clinical spectrum of AA in this locality over the last decade. The 2016 national population statistics from the regional headquarter office in Bamenda that provided population counts from all the local government areas within the northwestern region of the country.[32] This study aimed to describe the epidemiology of AA in the northwestern region of Cameroon.

Methods

Study design and setting

A retrospective population-based cohort observational study was conducted to estimate the population incidence of appendicitis and to evaluate the demographic features as well as seasonal variation of AA using the medical database of a tertiary hospital, northwestern region of Cameroon from January 2006 to January 2016. The National Institute of Statistics, Bamenda Regional Office, Bui-Division -Population Data of Cameroon in 2016 was used to estimate the standardized annual incidence of appendicitis in the locality. The hospital is a 250-bedded tertiary hospital (with 70 surgical beds). The hospital serves as the main referral center for an estimated population in excess of 3 million and a land area with a radius of over 80 km. Also, as Catholic Health Training Institute, the hospital has maintained excellence in standards which has no equal in the entire northern half of Cameroon.

Study population and procedure

During the study period under review, we obtained data for the study from operative, laboratory registers, patient records, and especially from the surgeon's operation notes as well as the histopathology report for all operations undertaken at the Hospital. Additional detailed data covering the medical records of patients was further obtained so as to ascertain the total and monthly breakdown of outpatient department visits, admissions and specimens received processed and reported in the pathology department over the entire ten- year study period. The study data comprised of detailed socio-demographic of the patients, month of admission, preoperative diagnosis, hospitals where operation was done, the date of the operation, the operative findings including incidental findings and whether or not appendectomy was done as a primary or secondary operation as well as intra-operative diagnosis as recorded in the surgeon's operative notes and the histopathology report. A comprehensive review of all the appendectomy slides was done and for missing slides a new section is made from the tissue block or cassettes. A histologically confirmed specimen is taken as a positive diagnosis of whether or not the operative findings concur. A negative histologic diagnosis is taken as normal appendix regardless of the findings in the surgeon's operative notes. The entire data were organized on an excel spreadsheet and relevant remarks were adjudged depending on the observed peculiarities of individual data. Subsequently, independent assessment of the data was done by two staff who took their time to cross check the data for completeness, accuracy and consistency. Pathologically confirmed specimens of appendicitis were analyzed against socio-demographic data of the patients.

Statistical Analysis

All data were entered in an excel database (Excel 2007, Microsoft corporation®) and analyzed using the Statistical Package for the Social Sciences (SPSS) version 22. Student t-test was used for analysis of parameters and chi-square test for the assessment of different categorical data and calculations were also aided with the Number Cruncher Statistical software (NCSS) where applicable. Inferential descriptive statistics was used to present data using simple percentages, tables and figures etc.

Ethical Considerations

Ethical approval was obtained from the Caritas Foundation Healthcare Ethical Review Committee. Approval No: DTAD/11/485/148/2019. Confidentiality was ensured by not writing the names of patients on proforma in accordance the Helsinki declaration. Reporting

The reporting in this study was achieved with STROBE / STROCSS guidelines.[34,35]

Results

Patient's characteristics

A detailed review of data from the entire hospital sources during the decade under study showed an estimated total of 2,504,058 visits in the outpatient department with an average of 250,405 visits per annum which represent (number [n]=1,953,165; 78%) adults and (n=550,893; 22%) children which are regarded as any patient whose age is equal or below 12 years. There was a total of (n=1,126,826; 45%) males and (n=1,377,232; 55%) females the overall Male: Female ratio was 1:1.22. The total numbers of hospital in-patients were 209,712 admissions which represented an average of about 20,970 admissions per annum comprising of (n=90,176; 43%) males and (n=119,536; 57%) females. We equally obtained additional data from the Cameroon Population Census of 2016 from all sub-divisions within 80 km radius of our referral tertiary hospital as presented in Figure 1 and Table 1; showing the list of various geographical locations from where the appendectomy specimens of the patients were sent to the central laboratory for histological study. Consideration also given to the various communities further away from the hospital from where AA patients would travel to our Hospital for medical and surgical care or the appendectomy specimens would have to be transported to the central histopathology laboratory for analysis. The total population count according to the 2016 census in the reference area was 1,753,460 persons.

Characteristics of the acute appendicitis

During the study period, the hospital medical record showed that an estimated total of 32,480 surgical operations with appendectomy accounting for 1,250 (3.85); therefore, the standardized incidence rate of appendicitis was 3.85 per 100,000 per annum. There was a total of 48,236 solid tissue specimens delivered to the histopathology department of the central laboratory representing those from our center and all other health facilities in the area. Of this total, there were 784 appendix specimens constituting 1.6% of all surgical solid specimens received. Of the 784 specimens of appendix received; histopathological diagnosis of appendicitis was established in 772 cases which form the study population. This gave a mean of 38 appendectomies per year or around 3 appendectomies per month in a population of 1,753,460. Therefore, this represents a population incidence for appendicitis of 2.2 per 100,000 per year. Furthermore, appendicitis cases are made up 0.94%, 1.53%, and 2.86% of the total hospital admissions in 2006, 2007, and 2010, respectively. These preceding figures represent an increasing population incidence of AA in both sexes almost in a similar pattern. The overall mean age was 28.64 ± SD 10.12 years with 6% below the age of ten and 1.5% above 60 years based on Table 2 and Figure 2. The highest incidence in males and females occurred in the second and third decades, respectively. Incidences were higher during the rainy season (April to September) 68%, $P < 0.05$), with peaks from June to August, when 42.5% of all cases presented.

Discussion

Epidemiology

According to Offili OP et al, "the epidemiology of AA is intriguing, and the disease is considered to have multiple etiological factors [10]. There is a significant variation in the incidence of appendicitis which varies substantially by country, geographical region, race, sex, age, and seasons".[5,8,25] Our finding of the population incidence rate of appendicitis of 2.2 per 100,000 per annum in northwestern Cameroon came after an exhaustive review of our data as well as the national census figures of 2016 for integrity (Figure 1 and Table 1). This figure is highly remarkable for being one of the lowest incidence rates available in the world literature. Some authors have reported that "there is significant difference in incidence rate of AA between the developed and developing countries that can be as high as ten folds difference in some instances such as between Finland and Thailand and between Spain and Ghana".[33,36-41] The greatest

question in the mind of many clinicians in the sub-saharan African countries like Cameroon is that are we under-diagnosing appendicitis? In some resource limited healthcare facilities from the author's candid opinion, there exit very few cases of sharp practices of discarding appendix specimen post-operatively supposedly due to a number of reasons including: a) inadequate resources to support the preservation, and processing of the biopsy specimen; b) poverty making the patient to be unable to pay out of pocket for the histopathology; c)ignorance on the part of the in-experienced clinician in such settings; hence completely unaware of the value of the histopathology report and the medico-legal implications of such decisions. It remains unknown whether these gross actions or inactions could significantly impact on the overall incidence of appendicitis; therefore, will require another study to substantiate the statistical significance in the long run.
In addition to the above, "some literatures have noted significant seasonal variation in the incidence of AA. Even in the same countries, appendicitis tends to show long-term temporal difference in incidence that has been thought to be related to changes in social indices like quality of housing and sanitation as exemplified by a standardized incidence rates of 570 per 100,000 in 1955 and 370 per 100,000 in 1987 occurring in Italy and also a standardized incidence rate of 652 per 100,000 in 1970 and 164 per 100,000 in 1999 in Greece". [25-31,42,43]

Risk factors for appendicitis

There has been reports of increasing incidence of appendicitis in African countries by some authors in the last few decades; which therefore, confirmed the findings of our study. [5,9-12,44] However, this contrasts with the common findings of reducing incidence in a larger part of the developed world.[5,6,8] Several reasons could be adduced to this, ranging from the very youthful African population and changing to the Western lifestyle.[7,13]
The predisposing factors to appendicitis are thought to be multifactorial, ranging from dietary, age, genetic predisposition, viral and bacterial infections, and parallel changes in humidity.[24] Vascular disorders, stressful life [7], smoking [45], and inadequate childhood breast feeding [46] are also being suggested by some authors. The increasing number of 'fast food' restaurants where mainly high-carbohydrate, low-fiber diets, confectionaries, and sweets are served could have contributed to the increase in the incidence, as an increasing number of young men and women, at times the whole family patronize these facilities, thus consuming less of the traditional high-fiber, less sugary diet. Large consumption of sweets and sugary diets has been implicated by some authors.[47,48] The mean age of presentation in our study is 28.64 years. However, this contrasts with most studies that suggest peak incidence in the second decade of life.

Immunological considerations

Some authors have suggested that "immunological factors may play roles in the pathogenesis of appendicitis.[22,49] Barker and colleagues have championed the belief that appendicitis is a disease that prevails in communities with good public health services and housing in place and, by implication, lower in those without these social indices[17,18,20,21]; This suggests an explanation for the observed low population incidence of appendicitis from developing countries in Asia and Africa".[33,40] Surgeons with working experience in sub-Saharan countries like Cameroon are made empirically aware of this difference in the incidence of appendicitis when they move to developed countries in Western Europe and North America. With the relative rarity in the first decade and progressive decline after the third decade, it may be inferred that the peak incidence seems to coincide with the age endowed with the most active lymphoreticular activity in the mucosa-associated lymphoid tissues, which make up most of the appendix.[30,31] According to Ashley who reported an excess of appendicitis during spring, implicating a high prevalence of viral infections as predisposing factor among others during these months,[30] which was corroborated by Sanda et al[31] who suggested intense challenge to the mucosa-associated lymphoid tissue in the dust, therefore implicating increased exposure to allergens during the sandstorms of the Spring months, in the Arabian Peninsula.

Appendicitis in tropical population

In the course of this study, we found that there is paucity of literature on appendicitis from Cameroon.[3,50] This confirms why the authors cannot find any study from Cameroon that calculated a standardized annual incidence rate which is one of the goals of this study. The question is "why is appendicitis so uncommon in North western Cameroon and possibly the rest of the country and region as well?" This study produced a standardized annual incidence rate of appendicitis in Cameroon to be 3.85 per 100,000 per annum. There have been serious concerns about the public health indices in most tropical African population like ours; "an environment where the indices like sanitation, sewage disposal, quality of water supply is such that water-borne gastrointestinal diseases like poliomyelitis, hepatitis viruses, shigellosis, cholera, typhoid enteritis, giardiasis and amoebiasis are prevalent. Endemic poverty and a lack of strict compliance with sanitary standards enforceable by public health authorities play contributory roles. This describes the type of situation that was prevalent in Europe, particularly in the United Kingdom preceding the introduction of housing edicts that preceded the outbreak of appendicitis in the late 19th century as reported by Short".[51] In the submission of Offili OP et al on the etiopathogenesis of AA, "it has been suggested that the endemicity of these water-borne gastrointestinal pathogens listed above in the water supply of children living in developing countries makes the frontline immune systems in the gastrointestinal systems tolerant of many less potent pathogens; whereas in children living in developed countries where these pathogens are rare, the immune system would mount an elaborate response that would cause the lymphoid follicles in the wall of the appendix to hypertrophy to the extent of causing occlusion of the lumen to cause appendicitis irrespective of the presence or absence of fecoliths".[10] This hypothesis may ultimately lay credence on the supportive evidence to explain why in most tropical African population like Cameroon, Nigeria and Ghana, for example, typhoid perforation of the ileum competes with appendicitis for supremacy in incidence.[52,53]

Most authors reported a higher incidence of appendicitis in males. [5,24,25,30] The finding of Male: Female 1: 1.22 in this study suggests that the incidence is marginally higher in females, which contrast to the finding of Ayoade et al from Nigeria.[27] We are seeing a scenario where "the young females here tend to have a preference for a highly-refined diet, including confectionaries, which prolong the colon transit time, with the aim of reducing bowel motion frequency and maintaining a slim stature. This has been found to increase the possibility of developing appendicitis, diverticular diseases, and even colonic malignancies in South Africa".[48,54] Appendicitis has also been implicated and closely related to the high frequency of occurrence of intestinal parasites in the developing world. The commonly associated parasites are Schistosoma mansoni, Schistosoma haematobium, Enterobious vermicularis, Ascaris lumbricoides, Entamoeba histolytica, and pinworm, among others. Badmus et al.[55], and Adebamowo et al.[56], have reported some cases of schistosomal appendicitis from south western Nigeria.

Appendicitis is generally reported as a disease of young age. The usual finding by majority of authors worldwide is that of the highest incidence of AA which was seen in the second and third decades of life. In this series, the overall mean age of 28.64 years is in concordance with that cited by Al Omran et al.[5], and others. The age distribution has a similar pattern in both sexes; this supports the non-influence of sex or the X-chromosome as a predisposing factor to appendicitis.[30]

Seasonal variation and appendicitis

In this series, even though cases of appendicitis present to the hospital throughout the year, but we receive more cases at some particular months of the year than the others. Incidentally also, these occurrences tend to vary from region to region. Many authors reported that higher incidences of AA are observed to be associated with summer months. [5,26,57] The months of May to October present a high incidence (with peaks in June to August) in this study; this is in-keeping with the findings from California[25] and Italy[28] as seen in Table 3 and Figure 3. The presence of seasonal variation shows the possibility of heterogeneous extrinsic factors such as, humidity, allergens, sun radiation, viral and bacterial infections in

the etiogenesis of appendicitis.[24,58] In agreement with other studies, we observed in this series a steady increase in the number of cases from the month of April, which corresponds with the onset of the rainy season, the intensity of which increases toward the months of July, August, and September. Higher humidity, which occurs during this period, has been implicated by these authors.[24,58] Khaevel et al, also postulated that "the importance of the actual reduction of sun radiation and vast fluctuations in air temperature, in the incidence of appendicitis.[58] Increase in the incidence of bacterial and viral infections (causing lymphoid hyperplasia leading to appendix lumen obstruction)[59] and parasitic infestations during this period could also contribute to the higher incidence of appendicitis, in a region where the climate is characterized by high humidity and heavy rainfall, in an environment with poor sanitation. Allergic reaction to pollen from flowers and palm produces,[60] for example, maize, during the rainy period may also account for some of the cases, which appear as lymphoid hyperplasia; therefore, a form of immunological response; otherwise referred to as the mucosa-associated lymphoid tissues hyperplasia, which make up most of the appendix".[59,60]

Limitations of The Study

1. Retrospective nature of the study could be marred by poor record keeping as noted in the incomplete data in less than 10% of the total patients managed.
2. Lack of Electronic Medical Record System in one of the hospital data studied in the past years until January 2018 with resultant loss of data.
3. Delay in patients' presentation, and compounded by the on-going anglophone- crisis
4. Poverty, ignorance, false beliefs and insufficient health infrastructure, in the sub-region of Cameroon are amongst the lists of possible limitations of this study.

Conclusion

Appendicitis is very uncommon in northwest Cameroon. The increasing incidence of the disease in both sexes in this region may be due to the change to a Western lifestyle. The age distribution has a similar pattern in both sexes and 85% are 40 years or less, although the incidence is marginally higher in females. Higher prevalence of infections and allergens from pollens in the rainy season could contribute to a higher incidence of appendicitis.

Recommendations

1. Full implementation of Electronic Medical Record System in all our local hospitals in the sub-regions for a comprehensive data base will support improved future research on the disease.
2. There is an urgent public health concerted effort aimed at improving health care seeking habit of the population.
3. Educating the populace on early and prompt diagnosis, adequate resuscitation as well as early surgery in patients with acute appendicitis to keep the morbidity and mortality low.
4. Patients who are misguided by false beliefs can be better educated by public enlightenment.
5. Effective government legislation on indiscriminate consumptions of herbal remedies, as substitutes for orthodox medicine.
6. It is imperative for prompt and early resolution of ongoing Anglophone crisis and in resource constrained setting as ours, an improvement of existing health infrastructure.
7. There is also a strong need for collaboration and integration of the Traditional medicine and Biomedical practices as advocated by the WHO; so as to harness the gains by all and sundry.
8. Functional health insurance for all citizens is mandatory.

9. Finally, we recommend a prospective study, preferable a multi-center one, to ascertain the accurate statistics on epidemiology, risk and prognostic factors of the disease.

Abbreviations

Strobe: The Strengthening the Reporting of Observational Studies in Epidemiology Statement: guidelines for reporting observational studies

Strocss: The Strengthening the Reporting of Cohort Studies in Surgery.

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Conflict of interest

No

Author's Contributions

The Author conceived of the study and participated in its design and coordination as well as helped to draft the manuscript; the author also read and approved the final manuscript.

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