Original Article

Histopathologic analysis of appendectomy specimens

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ABSTRACT

Background: Acute appendicitis is one of the common conditions requiring emergency surgery. A retrospective study was performed to determine various histopathological diagnoses, their demographics and the rates of perforated appendicitis, negative appendectomy and incidental appendectomy.

Materials and Methods: Histopathological records of resected appendices submitted to histopathology department Chitwan medical college teaching hospital over the period of 2 yrs from May, 2009 to April 2011 were reviewed retrospectively.

Results: Out of 930 specimens of appendix, appendicitis accounted for 88.8% with peak age incidence in the age group of 11 to 30 yrs in both sexes. Histopathologic diagnoses included acute appendicitis (45.6%), acute suppurative (20.8%), gangrenous (16.3%), perforated (1.7%), resolving /recurrent/non specific chronic appendicitis (2.5%), acute eosinophilic appendicitis (1.2%), periappendicitis (0.2%), and carcinoid tumour (0.1%). Other important coexisting pathologies were parasitic infestation (0.2%) and Meckel’s diverticulum (0.2%). Negative appendectomy rate was 10.8% and three times more common in females with peak occurrence in the age group of 21-30 yrs. There were 10 cases of acute appendicitis in incidental appendectomies (2.5%, 24 cases) with 7 times more common in females of age group of 31- 60 yrs.

Conclusion: There is a high incidence of appendicitis in adolescents and young adults in central south region of Nepal. Negative appendectomy is also very common in females. Incidental appendectomy in elderly females may have preventive value.

INTRODUCTION

Acute appendicitis is one of the most common surgical causes of acute abdomen. The lifetime risk for appendicitis is 7%; commonly occurring in adolescents and young adults.¹ The rate of acute appendicitis varies among countries. In USA, from 1979 to 1984 the annual appendicitis incidence rate in different parts of the country varied from 94 to 154 per 100,000.² Declining rates of acute appendicitis have been reported in the United States and Europe.³ In the UK, at North Tees Hospital, the incidence of acute appendicitis declined from about 100 to 52 per 100000 population from 1975 to 1991.² In developing countries, the incidence is increasing in most urban centers, probably due to adoption of western diet.⁴

Despite of advances in technology and imaging modalities, there is dilemma in the clinical diagnosis of acute appendicitis. Histopathological examination still remains the gold standard method for the confirmation of the
appendicitis. Not only the pathologic diagnosis of acute inflammation, at times unusual findings such as incidental tumours noted in the appendix highlights the importance of the pathologic analyses of every single resected appendix.

This study aims to determine the various histologic diagnoses of all surgically removed appendices and to find out the age and sex related incidence of appendicitis, the perforation rate and the rate of negative and incidental appendectomies. In addition, we attempt to find out the possible causes of negative appendectomy.

**MATERIALS AND METHODS**

This was a retrospective study conducted in the pathology department at Chitwan Medical College Teaching hospital during the two years period from May, 2009 to April 2011. All the surgically resected appendices submitted to department of pathology were included in this study. All emergency appendectomies and interval appendectomies performed on clinically suspected appendicitis, and incidental appendectomies which were performed during other abdominal or pelvic surgeries were included. Relevant clinical data, gross findings and histopathologic diagnoses were retrieved from pathology record book and computer databases. Statistical analysis was done by SPSS 16.00.

Negative appendectomy was defined as one which is performed for a clinical diagnosis of acute appendicitis but in which the appendix is found to be normal on histopathological examination.

**RESULTS**

Total of 930 specimens of appendix were received in the histopathology department during the period of 2 years from 2009 to 2011. Of total 930 appendectomies, there were 898 emergency appendectomy and 8 interval appendectomy performed for clinically suspicious appendicitis, and incidental appendectomies which were performed during other abdominal or pelvic surgeries were included. Relevant clinical data, gross findings and histopathologic diagnoses were retrieved from pathology record book and computer databases. Statistical analysis was done by SPSS 16.00.

Negative appendectomy was defined as one which is performed for a clinical diagnosis of acute appendicitis but in which the appendix is found to be normal on histopathological examination.

Total 817 (88.8 %) cases were found to have histologically proven appendicitis. This accounted for overall incidence of 20% of appendicitis among the total surgical specimens (n=4069). There were 387 (47.4%) males and 430 (52.6%) females among 817 cases of appendicitis with the male: female ratio of 1:1.1. The mean age for female was 30.5±15.08 yrs with a range of 2 to 84 yrs and the mean age for male was 26.6 ±15.4 yrs with a range of 1 to 75 yrs. The peak age incidence of appendicitis was found in the age group of 11 to 30 yrs. However, peak age incidence for males was 11 to 20 and 20 to 30 yrs for females. More than 80% cases of appendicitis occurred below the age of 40 yrs.

All acutely inflamed appendices had peak incidence in the age group of 11 to 30 yrs. Chronic/ recurrent/ resolving and eosinophilic appendicitis were commonly seen in the age group of 21 to 40 yrs. Sex distribution of inflamed appendices at various stages is shown in Table 1.

Perforation rate was 1.9% (16 out of 817 cases). Perforated appendicitis was seen more commonly in females at the age interval of 11-30 yrs. The rate in adults in the age group of 15 to 50 yrs was significantly different (p= <0.05) when compared to ages below 15yrs and >50yrs.

Parasite was present in 2 histologically proven appendicitis of which, one had luminal parasite (unidentified species) associated with acute appendicitis. Another was a case of chronic appendicitis with suspected parasitic infestation due to presence of foreign body reaction associated with transmural eosinophilic infiltration. One carcinoid tumour (0.1%) was diagnosed incidentally in a patient clinically suspected as appendicitis. The tumour was found at the tip of the appendix measuring 1 cm in length with no mesoappendiceal or distant metastasis and thus the patient was kept under close follow up without further surgical procedure.

Some of the clinically suspicious appendicitis which was proven to be appendicitis later by microscopic examination had other associated histologic findings. These included endosalpingiosis of appendix, broad ligament cyst, mesenteric cyst, villotubular adenoma of Meckel’s diverticulum.

**Incidental appendectomy**

There were total 24 cases (2.5%) of incidental appendectomy of which 3 were males and 21 were females. The most common primary surgery was total abdominal hysterectomy with bilateral salpingo-oophorectomy (16 cases) followed by oophorectomy with or without adenectomy (3 cases), GI surgery (4 cases; 1 female, 3 males) and one emergency exploratory laparatomy (1 female). The age ranged from 7 to 70 years and the peak age interval was 31 to 60 years. Of total 24 cases, 10 had histologic diagnosis of acute appendicitis; 8 of them were females and remaining 2 were males. The Table 3 shows the primary diagnoses associated with appendicitis in incidental appendectomy. Acute appendicitis was seen between the age interval of 21 to 80 years with increased frequency in the age group 41 to 60 years. Six out
of 10 cases of incidental appendectomy that were associated with appendicitis, had features of peritonitis. Remaining 4 cases of positive incidental appendectomy were associated with adenomyosis, fibroid and abortion.

**DISCUSSION**

Acute appendicitis has been the most common surgical emergency for a number of decades and the appendectomy is the most frequently performed abdominal operation. In the western world, acute appendicitis accounts for about 40% of all surgical emergencies. It is rare in Asian and African subcontinent; however recent literature reviews show that there is an increase in incidence of appendicitis in African countries with adoption of western life style and diets. In contrast to other studies, which showed male to female ratio ranging from 1.1 to 2.9:1, we had slightly female preponderance with the female male ratio of 1.1:1. However, it was observed that males at adolescent age group had higher incidence than the females similar to other studies. Migration of majority of male adults to foreign countries in search of work has been a trend here and might have disturbed the overall population structure. Therefore, this could be the reason for the overall higher incidence of acute appendicitis in females than males.

Maximum frequency of histologic diagnoses was acute appendicitis (45.6%) followed by acute suppurative (20.8%) and gangrenous appendicitis (16.3%) similar to other study done by zulfikar et al. Nabipour et al found poor positive correlation between the histologic stage and age and sex incidence. In the present study, the age incidence followed a similar pattern in all acutely inflamed appendicitis occurring in young adults (i.e. the age group of 10 to 30 yrs). However, sex incidence was higher in males in acute suppurative and acute gangrenous appendicitis and it was higher in females in acute appendicitis and perforated appendicitis (p= 0.01).

Eosinophilic appendicitis and chronic/ recurrent/ resolving appendicitis were more common in females and in slightly older age group. The frequency of eosinophilic appendicitis was 1.2% in our study which was closer to the incidence of 1%, found by Park et al. The diagnosis of chronic / recurrent / resolving appendicitis is still controversial; and its existence has been debated. Some authors postulated that chronic or recurrent pelvic pain may be, to some extent, attributed to a chronically inflamed appendix; and, when

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**Table 1: The Distribution of Histopathologic stages of appendicitis by Sex**

<table>
<thead>
<tr>
<th>Histologic stages</th>
<th>Female (n=428)</th>
<th>Male (n=389)</th>
<th>Total (n=817)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute appendicitis</td>
<td>57.5% (246)</td>
<td>46.0% (179)</td>
<td>52.0% (425)</td>
</tr>
<tr>
<td>Acute suppurative appendicitis</td>
<td>18.7% (80)</td>
<td>28.0% (109)</td>
<td>23.2% (189)</td>
</tr>
<tr>
<td>Acute gangrenous appendicitis</td>
<td>16.1% (69)</td>
<td>21.4% (83)</td>
<td>18.7% (152)</td>
</tr>
<tr>
<td>Perforated appendicitis</td>
<td>3.0% (13)</td>
<td>0.8% (3)</td>
<td>1.9% (16)</td>
</tr>
<tr>
<td>Eosinophilic appendicitis</td>
<td>2.1% (9)</td>
<td>0.5% (2)</td>
<td>1.3% (11)</td>
</tr>
<tr>
<td>Chronic/ resolving/recurrent appendicitis</td>
<td>2.6% (11)</td>
<td>3.3% (13)</td>
<td>2.9% (24)</td>
</tr>
</tbody>
</table>

Pearson chi square test: 27.385  P= 0.001

**Table 2: Other pathologic diagnoses in negative appendectomy**

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>No of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follicular cyst</td>
<td>1</td>
</tr>
<tr>
<td>Twisted ovarian cyst</td>
<td>1</td>
</tr>
<tr>
<td>Haemorrhagic endometriotic cyst with periappendicitis</td>
<td>8</td>
</tr>
<tr>
<td>Periappendicitis</td>
<td>1</td>
</tr>
<tr>
<td>Meckel’s diverticulitis</td>
<td>1</td>
</tr>
<tr>
<td>Fimbrial hematoma</td>
<td>1</td>
</tr>
</tbody>
</table>

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The incidence of appendicitis varies substantially by country, geographical region, race, socioeconomic status, dietary habits, hygiene, sex, age and season. The high incidence of appendicitis, particularly in this region could be explained by the improvement in socioeconomic status that would directly affect the dietary habits with high intake of meat, increased health awareness and an easy access to the hospital.

Age incidence of appendicitis were higher in the second and third decade, about 80% of appendicitis occurring below 40 years of age in concordance with various studies. In contrast to other studies, which showed male to female ratio ranging from 1.1 to 2.9:1, we had slightly female preponderance with the female male ratio of 1.1:1. However, it was observed that males at adolescent age group had higher incidence than the females similar to other studies. Migration of majority of male adults to foreign countries in search of work has been a trend here and might have disturbed the overall population structure. Therefore, this could be the reason for the overall higher incidence of acute appendicitis in females than males.
removed in an otherwise anatomically normal pelvis, can reduce pain in one half of the patients. In our series, it was found to be 2.5% in the young and older adults, while it was still higher in other study. Therefore, recurrent abdominal pain should not be overlooked and a high index of suspicion of appendicitis is essential to avoid repeated unnecessary admissions.

The perforation rate was low (1.9%) in our study similar to that shown by other studies. Number of series however had quite higher values, ranging from 8.3 to 23.2%. We also observed that the age incidence of the perforated appendicitis was quite different, in comparison to other studies. We had a higher incidence of perforation rate in the age group of 11-30 yrs when compared to that of age below 15 yrs and above 50 yrs (p value <0.5). Most of these studies showed the extremes of age with higher perforation rate. The decrease frequency might be due to early visit in the hospital in most of the cases and the prompt decision to operate for suspected appendicitis by the surgeons.

Parasitic infestation is thought to be one of the causes of luminal obstruction of appendix leading to appendicitis. Several studies have found luminal parasites in the appendix associated with or without appendicitis in the range of 0.3 to 3.15%. Commonly found parasites include enterobius vermicularis and schistosoma species. In our study, only 2 cases had parasitic infestation (0.2%), out of which one had unidentified parasite in the lumen of chronically inflamed appendix and another was suspicious due to presence of foreign body reaction and transmural eosinophilic infiltration.

There was only one case of incidental carcinoid tumour (0.1%). The literature review showed the incidence of carcinoid tumour ranging from 0.1% to 1.05% mostly found incidentally during microscopic examination. In the present study, the tumour was not associated with acute inflammation of the appendix and the abdominal pain could be explained due to the elaboration of inflammatory mediators.

Negative appendectomy

In our study, negative appendectomy rate of 10.6% falls within the acceptable range of 10 to 20%. Various studies has shown a wide range of rate that falls between 6.1 to 34.2%, with higher values in females. The present study showed females having higher rates of negative appendectomy frequently occurring within the younger age group of 11 to 30 yrs. Edino et al and Marudanayagam et al also presented the similar finding which showed a high incidence in the age group of 10-19 yrs and 11-30 yrs respectively. Similar to other studies, we found other pathologies such as ovarian cyst, Meckel’s diverticulitis and periappendicitis as the causes of acute abdominal pain in negative appendectomy.

Therefore, especially in females, other causes of abdominal pain should be searched for if the appendix appears normal during operation. The use of diagnostic laparoscopy followed by appendectomy if necessary in fertile female patients was found to reduce the rate of negative appendectomy several fold. However, this is also true that most of the negative appendectomy cases are relieved of pain after surgery. Wang et al demonstrated that TNF-α and interleukin-2 expression are sensitive markers of inflammation in appendicitis. A significant number of histologically normal appendix specimens (22.5%) showed increased cytokine expression, indicating an inflammatory reaction. Therefore, normal-looking appendices have a 22% chance of being inflamed on further sophisticated investigations.

Incidental appendectomy

The rate of incidental appendectomy was only 2.5% in our study. One series demonstrated the incidence of incidental appendectomy.
appendectomy 1.13/1,000 persons per year. Similar to other studies, incidental appendectomy was 7 times more common in females undergoing pelvic surgery above the age of 30 years. The removal of appendix was justified in 37.5% of incidental appendectomy showing positivity for acute appendicitis. Of total 10 cases, coexisting acute appendicitis in six cases could be explained by virtue of peritonitis associated with primary disease, leading to appendicitis, as a result of contiguous spread of inflammation to the appendix. However, no plausible reason could be found in the rest four cases of acute appendicitis which were associated with primary gynaecologic diseases. These 4 cases (16.6%, n= 24 cases) of acute appendicitis were truly incidental finding detected commonly in the age group of 41- 60 yrs and, thus prevented the further need of appendectomy. The studies that evaluated the mortality and morbidity of incidental appendectomy associated with appendicitis were found to be insignificant and thus the authors have advocated incidental appendectomy in all abdominal or pelvic surgeries. Therefore, the practice of incidental appendectomy in uncomplicated abdominal or pelvic surgery might decrease the rates of mortality and morbidity associated with appendicitis and appendectomy in the elderly.

CONCLUSION

The incidence of appendicitis is high, in the second and third decades of life and slightly higher in females. Low perforation rate indicates a better prospective regarding morbidity and mortality. Findings of pelvic pathologies in females, such as ovarian cysts, in negative appendectomy emphasize the usefulness of the laparoscopic surgery that would help to minimize negative appendectomy rate. Incidental appendectomy may have preventive value in elderly females. Finally, an unusual finding such as carcinoid tumour in the clinically suspected acute appendicitis reflects the value of histological examination of every resected appendix, the presence of which would alter the further management. Incidental appendectomy in elderly females may have preventive value.

REFERENCE