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Original Research Article

A study to find out correlation between clinical diagnosis and histopathological diagnosis in patients with acute appendicitis undergoing surgical treatment

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ABSTRACT

Background: Acute appendicitis is one of the most frequent abdominal emergencies and appendectomy subsequently the most common emergency operation performed all over the world. The aim of the study is to evaluate the reliability of Clinical Diagnosis for diagnosis of acute appendicitis and correlate it with the gold standard and absolute diagnostic modality, histopathology.
Methods: This is a prospective study carried out in 150 patients who were admitted under department of surgery, AFMC Pune, Maharashtra from 1st July 2014 to 31st June 2016 for a clinical diagnosis of acute appendicitis.
Results: In our study overall negative appendectomy rate was 18.7% (12.37% in male and 30.19% in female). Hence in the overall females had more negative appendectomy rate compared to males. In our series a score of >7 using Alvarado system had a total sensitivity of 72.95%. While sensitivity increases to 99.18% when score of >5 used as cut-off.
Conclusions: Alvarado scoring system is beneficial in decreasing negative appendectomy rate and thus reduces complication rates. It is effective in the diagnosis of acute appendicitis in both men and females but some other diagnostic modality may be necessary to ascertain the diagnosis in females along with the clinical scoring system to rule out other pelvic pathology and to reduce negative appendectomy rate in females.

Keywords: Acute appendicitis, Appendectomy, Alvarado score, Clinical diagnosis, Histopathological diagnosis

INTRODUCTION

The appendix represents quite a mystery. For many years it was believed to be a vestige of our distant ancestors; the trace of a caecum, a part of many animals large intestine.[1] This theory was put forward by Charles Darwin but was mostly refuted in 2013.[2] Another theory claims that the appendix acts as a safe haven for gut bacteria in case of disease; the bacteria could regenerate from this point into the rest of the intestine.[3] Whatever its true function, the appendix can cause severe problems when it becomes infected. The importance of vermiform appendix in surgery results mostly from its propensity for inflammation, which results in the clinical syndrome known as acute appendicitis and the subsequent complications, even mortality.

Acute appendicitis is one of the most frequent abdominal emergencies and appendectomy subsequently the most common emergency operation performed all over the world.[4] Lifetime risk for a person suffering from this acute condition ranges around 12% for men, 25% for

women and 7% overall, with mortality rates having significantly reduced from 9.9 per 100,000 to 0.2 per 100,000 in uncomplicated cases but 1-5% mortality in complicated cases which appears to be significant hence the purpose of studying the contributing factors for this common condition.[4]

Simple appendicitis can progress to perforation, which is associated with a much higher morbidity and mortality, and surgeons have therefore been inclined to operate when the diagnosis is probable rather than wait until it is certain.[5] The surgical principle about acute appendicitis "when in doubt, take it out", is not correct in view of the number of major and minor complications following appendectomy.

Owing to its myriad presentations, acute appendicitis is a common but difficult diagnostic problem. Despite more than 100 years experience, accurate diagnosis still evades the surgeon. It cannot be diagnosed with 100% accuracy in the early stage. Various laboratory and imaging investigations though helpful are not 100% diagnostic. They have to be correlated to history and physical findings to achieve the acceptable degree of diagnostic accuracy. The accuracy of the clinical examination has been reported to range from 71% to 97% and varies greatly depending on the experience of the examiner.[6] Routine history and physical examination still remain most practical diagnostic modalities.[7] Absolute diagnosis, of course, is only possible at operation and histopathological examination of the specimen.[8]

However, because missed ruptured appendixes have dire consequences, surgeons have traditionally accepted a 20% rate of negative findings at appendectomy and the removal of a normal appendix.[9] The rate of negative appendectomy (Removal of a normal appendix in patients with other causes of abdominal pain) is reported to be between 20% and 30%.[9,10] Attempts to increase the diagnostic accuracy in acute appendicitis have included computer-aided diagnosis, imaging by ultrasonography, laparoscopy, and even radioactive isotope imaging.[11-14] Various scoring systems have been devised to aid diagnosis.[15,16]

Clinical scoring systems are the good supporting tool for diagnosing acute appendicitis because they are simple, easy to use, noninvasive and do not require any special equipment. One such scoring system is MANTRELS SCORE, which is based on analysis of symptoms, signs and laboratory data and is easy to apply (Alvarado, 1986). The MANTRELS score was described in 1986 and has been validated in adult surgical practice.[17] The use of an objective scoring system such as the MANTRELS system can reduce the negative appendectomy rate to 0-5%.[16-18]

The aim of the study was to evaluate the reliability of Clinical Diagnosis for diagnosis of acute appendicitis and correlate it with the gold standard and absolute diagnostic modality, histopathology.

METHODS

This is a prospective study conducted at command hospital, AFMC Pune, after approval of the Institutional ethics committee, from July 2014 to June 2016.

Inclusion criteria

All consecutive patients with suspected acute appendicitis operated in this period (July 2014 to June 2016) were included in the study.

Exclusion criteria

- Patients with urological, gynaecological or surgical problem other than acute appendicitis and with mass in right iliac fossa were excluded from the study.
- All patients who refused investigation and treatment.

Procedure

All patients were thoroughly examined clinically, investigated and the demographics, presenting signs and symptoms were documented as per the proforma. Three symptoms, three signs, and two laboratory indicators included in Alvarado score were recorded preoperatively. According to the Alvarado score patients were categorized into three groups, score ≥7, ≤6 and ≤4: as it is standard to label those patients with a score ≥7 as diagnostic of appendicitis, score ≤6 as doubtful but potential candidates suffering from the disease and scores ≤4 unlikely to suffer from the condition.

Further, they were classified into 2 groups: group 1 clinically typical (Alvarado score ≥7), group 2 clinically doubtful (Alvarado score <7). All specimens of excised appendix were submitted to the pathology department for HPE. Clinical diagnosis correlated and analysed with the histopathological diagnosis of the specimen.

Finally negative appendectomy rate, sensitivity, the positive predictive value, negative predictive value, in order to correlate clinical diagnosis and histopathological diagnosis in acute appendectomy were calculated.

RESULTS

The study was carried out in 150 patients who were admitted under the department of surgery in all surgical units from 1st July 2014 to 31st June 2016 for a clinical diagnosis of acute appendicitis. Clinical examination was performed and investigations (TLC and shift to left) noted. Accordingly, data was calculated and observations and results were interpreted.

Age distribution of study cohort

In our study, it was observed that incidence of appendicitis was maximum in the younger age group of 21-30 years (46.7%) as compared to older population >50 years (7.3%), in fact trend seems to decrease as the age increase. Mean age of presentation in our study was 28.64 years (Table 1).

Table 1: Age distribution of study cohort.

Age group (in years)	Number of patients	Percentage (%)
≤10	4	2.7
11-20	41	27.3
21-30	70	46.7
31-40	18	12.0
41-50	6	4.0
51-60	5	3.3
>60	6	4.0
Total	150	100.0

Gender distribution of study cohort

In the present study Amongst the 150 patients of appendicitis who presented to us, 97 were male and 53 were female (Table 2). The male to female ratio in our study was 1.83:1.

Table 2: Gender distribution of study cohort.

Gender	Number of patients	Percentage (%)
Male	97	64.7
Female	53	35.3
Total	150	100.0

Frequency of various clinical parameter of Alvarado score

In the present study pain abdomen was the commonest presenting complaint and was present in all 150 patients but typical migratory pain from the umbilical region to right lower quadrant was present only in 88 (58.7%) patients. Anorexia was reported by 91 (60.7%) of patients. 109 (72.7%) patients were having nausea or vomiting.

Table 3: Frequency of various clinical parameters.

Clinical parameters	Number of patients	Percentage (%)
Migratory pain	88	58.67
Anorexia	91	60.67
Nausea/vomiting	109	72.67
Tenderness	150	100
Rebound tenderness	83	55.3
Fever	109	72.67
Leucocytosis	126	84
Shift to left	27	18

Among clinical signs, right iliac fossa tenderness was seen in all the cases. Rebound tenderness was present in 83 (55.3%) cases and 109 (72.7%) patients were febrile. Leucocytosis and shift to left were present in 126 (84.0%) and 27 (18%) patients respectively (Table 3).

Distribution of cases in various Alvarado score group

In our study we found that mean Alvarado score was 7.34 with a standard deviation of 2.06. The minimum score is 3 and maximum score is 10. Score was ≥7 in 70% (105) patients, 5-6 in 28.7% (43) patients and ≤4 in 1.3% (2) patients respectively (Table 4). 30% (45) patients were having score <7 and score of ≥7 were found in 70% (105) cases.

Table 4: Distribution of cases in various Alvarado score group.

Alvarado score group	Frequency	Percentage (%)
≤4	2	1.3
5–6	43	28.7
≥7	105	70.0
Total	150	100.0

Gender v/s histological findings in study cohort

In the present study out of 150 patients, 122 (85 male and 37 female) were found to have acute appendicitis on histopathological examination, while 28 specimens were reported as normal appendix (12 males and 16 females). So, negative appendectomy rate in our study was 18.7% (Table 5).

Table 5: Gender v/s histological findings.

Gender	Histopathological findings		Total
	Positive	Negative	
Male	85 (87.63%)	12 (12.37%)	97
Female	37 (69.81%)	16 (30.19%)	53
Total	122 (81.30%)	28 (18.70%)	150

Analysis of clinical parameters included in Alvarado score v/s final histopathological diagnosis

There were 84 out of 88 patients who gave history of migratory pain were found to have appendicitis on HPE (P value 0.001). 69 patients with anorexia and 95 patients with nausea/vomiting on presentation were positive for appendicitis (P value 0.034 and 0.005 respectively) (Table 6).

Analysis of patients group as per Alvarado score and its correlation with final diagnosis

By using Fisher's exact test p-value >0.05 therefore there is no association between Alvarado score with histopathological findings (Table 7).

Table 6: Analysis of clinical parameters included in Alvarado score v/s final histopathological diagnosis.

Clinical parameters	Histopathological result		Total	P-value
	Positive	Negative		
Migratory pain	84	4	88	0.001
Anorexia	69	22	91	0.034
N/V	95	14	109	0.005
R. tenderness	67	16	83	0.837
Fever	87	22	109	0.491
Leukocytosis	103	23	126	0.777

Table 7: Analysis of patients group as per Alvarado score and its correlation with final diagnosis.

Alvarado score	Histopathological findings		Total	P-value
	Positive	Negative		
≤4	1	1	2	0.107
5-6	32	11	43	
≥7	89	16	105	
Total	122	28	150	

Alvarado score v/s histopathological findings in study cohort for gender

Out of 97 males, 71 were in group 1 and 26 were in group 2 and out of 53 female 34 were in group 1 and 19 were in group 2. Overall negative appendectomy rate in males was 12.37% which is further low in group 1 (9.85%) in comparison to group 2 (19.23%).

Overall negative appendectomy rate in females was 30.19% which is further low in group 1 (26.47%) in comparison to group 2 (36.84%). The overall sensitivity of Alvarado scoring system in our study was 72.95% (Table 8).

Alvarado score 7-9 has more diagnostic value for diagnosing appendicitis compared to Alvarado score 5-6. Overall Alvarado score >5 has got more sensitivity for appendicitis (Table 9).

Table 8: Statistical values of Alvarado score when cut off score is taken as >7.

Gender	Alvarado score	Histopathological findings		Total	Sensitivity	PPV	NPV
		Positive	Negative				
Male	Group 1 (>7)	64	7	71	75.29%	90.14%	19.23%
	Group 2 (<7)	21	5	26			
	Total	85	12	97			
Female	Group 1 (≥7)	25	9	34	67.57%	73.53%	36.84%
	Group 2 (<7)	12	7	19			
	Total	37	16	53			
Total	Group 1 (≥7)	89	16	105	72.95%	42.86%	26.67%
	Group 2 (<7)	33	12	45			
	Total	122	28	150			

Table 9: Statistical values of Alvarado score when cut off score is taken as >5.

Alvarado score	Histopathological findings		Total	Sensitivity	PPV	NPV
	Positive	Negative				
≥5	121	27	148	99.18%	81.76%	50.00%
<5	1	1	2			
Total	122	28	150			

DISCUSSION

Acute appendicitis remains a common abdominal emergency throughout the world. The diagnosis of acute appendicitis continues to be difficult due to the variable presentation of the disease and the lack of reliable diagnostic tests. Though there are lots of advances in the diagnostic field with the invention of sophisticated investigations diagnosis of acute appendicitis remains an enigma for the attendant surgeon. None of the investigations like USG, CT, MRI can conclusively diagnose appendicitis.

It has been proven that some of the investigations already discussed are costly, time consuming; require more sophisticated equipment and expertise, while some are not feasible and not readily available.

Even today, a thorough clinical examination with basic investigations like WBC count remains the cornerstone in the diagnosis of acute appendicitis. With this background many eminent surgeons have been adopting different scoring systems in order to decrease negative appendectomy rate.

Although there has been some improvement in the diagnosis of acute appendicitis over the past several decades, the percentage of normal appendices reported in various series varies from 8 to 33%.[16] In the past few years various scores have been developed to aid the diagnosis of acute appendicitis. Although many diagnostic scores have been advocated, most are complex and difficult to implement in the clinical situation. The Alvarado score, is a simple scoring system that can be instituted easily. This score proved to be effective in many studies in patients with acute appendicitis.[22-24] It is simple to use and easy to apply, since it relies on history, clinical examination and basic lab.[25]

The present study was undertaken to find out the correlation between clinical diagnosis and histopathological diagnosis in cases of acute appendicitis. Clinical diagnosis is made on the basis of Alvarado score.

Our results and observations were discussed and compared with various other studies. Maximum number of patients in both sexes was in the age group of 11 to 30 years and the incidence reduced in the older age. Similar findings were reported in other studies also.[26,27]

Pain was the commonest presenting symptom and has been observed in all the cases (100%) included in the present series which is in close agreement with Waskale et al.[27] The classical shifting of pain from umbilical region to RIF was seen only in 58.7% cases. Next common symptoms observed were nausea/ vomiting in 72.7% of cases and anorexia in 60.7% of cases. Low grade fever was also present in 72.7% of cases. On clinical examination, tenderness at McBurney's point was the commonest sign (100%) which is similar to findings of Alfredo Alvarado.[17] Rebound tenderness was present in 55.3%.

For assessment, the patients were categorized into group 1 (Alvarado score >7) and group 2 (Alvarado score <7). Out of total 150 patients, 105 patients were in group 1 and 45 patients were in group 2. Out of 105 patients of group 1, 89 patients were reported positive and 16 patients were reported negative and out of 45 patients in group 2, 33 patients were reported positive and 12 patients were reported negative on HPE. The negative appendectomy rate in our study was 15.23% in group 1 and 26.66% in group 2. Overall negative appendectomy rate was 18.7%.

In the present series the males outnumbered females in the ratio of 1.83:1 which is slightly higher in comparison to other studies, this observation may be due to more number of beds are authorized for male patients in this centre.

Out of 97 males, score of >7 was in 71 cases and score of <7 was in 26 cases. 64 out of 71 males having score of >7 had acute appendicitis, while 7 (9.85%) patients had normal appendix on histopathological examination. Male patients having score of <7 were 26, out of which 21 patients had acute appendicitis, and 5 (19.23%) patients had normal appendix. Overall negative appendectomy rate in males was 12.37% which is further low in group 1 (9.85%) in comparison to group 2 (19.23%).

Out of 53 female patients, 34 cases had score >7 and 19 cases had score <7. Twenty five out of 34 females having score of >7 had acute appendicitis, while 9 (26.47%) patients had normal appendix on histopathological examination. Female patients having score of <7 were 19, out of which 12 patients had acute appendicitis, and 7 (36.84%) patients had normal appendix. Overall negative appendectomy rate in females was 30.19% which is further low in group 1 (26.47%) in comparison to group 2 (36.84%).

In our series a score of >7 using Alvarado system had a total sensitivity of 72.95%. While sensitivity increases to 99.18% when score of >5 used as cut-off.

Table 10: Comparison of our study with various studies.

Series	Sensitivity (%)
Kalan et al[21]	81.63
Denizbasi[20]	95.40
Al-Hashemy et al[26]	53.90
Shrivastava et al[19]	92.40
Present study	72.95

When compared with Al-Hashemy et al series it is evident that Alvarado scoring system is still has more sensitivity.[26] It can be used as a complementary method in diagnosing acute appendicitis.

Increased proportion (26.66%) of negative appendectomy is noticed for the Alvarado score <7 and significantly decreased proportion (15.23%) negative appendectomy is noticed for the Alvarado score >7.

In our series negative appendectomy rate in females with score <7 was 36.84% and with score >7 was 26.47%. Men with score <7 had negative appendectomy rate of 19.23% and with score >7 had negative appendectomy rate of 9.85%. Hence in the overall females (30.19%) had more negative appendectomy rate compared to males (12.37%), as the other diseases like pelvic inflammatory diseases were more common in the reproductive age group.

Since intra-abdominal infection in females, particularly lower abdomen, can be quite confusing, it is difficult to differentiate acute appendicitis from gynaecological conditions like twisted ovarian cyst and PID.

The Overall Alvarado score >5 has got more sensitivity (99.18%) in comparison to cut off of >7, where sensitivity decreases to 72.95% and those patients who

scored <5 did not require subsequent laparotomy, indicating the usefulness of the system in ruling out acute appendicitis.

Laparoscopy can be advised as a diagnostic tool to minimize negative appendectomy rates. In our present study, the usefulness of the system was demonstrated by reducing the number of negative laparotomies, especially in men and children. In women negative laparotomies were still high and this can be reduced by laparoscopy.

CONCLUSION

Alvarado scoring system can work effectively in routine practice as an adjunct to surgical decision-making in questionable acute appendicitis. It is a fast, simple, reliable, non-invasive, repeatable and safe diagnostic modality without extra expense and complications. Though we have not found statistically significant correlation between Alvarado score and histopathological diagnosis of acute appendicitis in our study however, it is beneficial in decreasing negative appendectomy rate and thus reduces complication rates especially in day care hospitals or peripheral hospitals where back up facilities like USG scan or CT scan is not available. Alvarado score is effective in the diagnosis of acute appendicitis in both men and females but some other diagnostic modality may be necessary to ascertain the diagnosis in females along with the clinical scoring system to rule out other pelvic pathology and to reduce negative appendectomy rate in females.

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