

“EVALUATION OF AIRS (APPENDICITIS INFLAMMATORY RESPONSE SCORE) SCORING SYSTEM IN PREDICTING OUTCOME IN PATIENTS WITH ACUTE APPENDICITIS”

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Abstract:

Background: The first appendectomy was performed in 1880 for the case of acute appendicitis in England. No perfect diagnostic evaluation tool exists if symptoms are vague in nature. There are multiple diagnostic approaches which include symptomatology, physical examinations, laboratory findings and imaging studies such as Ultrasonography (USG), Computerised Tomography (CT) of abdomen. Scoring system is a method which helps in estimating the probability of having the corresponding disease in a patient. Such scoring system is of a simple design and easy to implement. One of the system is Alvarado scoring system which is simple enough to apply and it is effective. This system lacks in certain aspects, it doesn't include C - reactive protein (CRP) as a variable. Appendicitis Inflammatory Response Score (AIRS) was introduced recently which was prepared in the view of the drawbacks in the Alvarado score, includes the CRP value in it. This score can help in diagnosing appendicitis in the suspected patients who require timely surgery or those who are in need of further evaluation.

Methodology: 130 patients with pain in Right Iliac Fossa with provisional diagnosis of Acute Appendicitis were taken for study. Informed, valid, written consent for surgery was taken and was operated by experienced surgeons. Intra-operative findings, histopathological reports, post-operative complications and post-operative hospital stay were recorded. Based on all above findings AIRS score was calculated.

Results: Out of 130 patients majority of the patients were found in the score of 5-8 with 67 (51.53%) patients. It was followed by 36 (27.69%) patients having AIRS score >8 and only 27 (20.76%) patients with score <4. This suggests the accuracy level of the AIRS score to diagnose the severity of the acute appendicitis in the study population.

Conclusion: AIRS aided in accurate diagnosis of acute appendicitis which can help in taking correct decision regarding the therapeutic approach to manage the patient surgically. AIRS scoring system can help in improving the overall health outcome of the patient due to correct management of the patients.

Introduction:

Reginald Fitz from Boston first identified inflammation of the appendix as a cause of right lower quadrant pain. He coined the term appendicitis and recommended early surgery intervention. Robert Lawson Tait performed the first appendectomy in 1880 for the case of acute appendicitis in England¹. Though even after almost 130 years later, diagnosing the cases of acute appendicitis remains a problem in the surgical diseases. This was shown in literature that there is a high negative laparotomy rate. In 2005 a study was performed in Netherlands in which it was found that almost 15% of the patients who underwent a negative appendectomy, this number is similar to another study which was done in Sweden². Even though mortality rate has improved since the advent of antibiotics in 1940. Acute appendicitis remains a common surgical disease to diagnose.

No perfect diagnostic evaluation tool exists to detect appendicitis if symptoms are vague in nature. In case symptoms are not clear then it might take longer than expected to detect the disease and this may lead to surgical complications. Furthermore, hasty operation with inaccurate diagnosis will lead to negative appendectomy, increasing the illness and treatment expenditure. Even with the advent of modern diagnostic tools, misdiagnosis of appendicitis has remained more or less constant^{3,4}.

There are multiple diagnostic approaches which include symptomatology, physical examinations, laboratory findings and imaging studies such Ultrasonography (USG) and Computerised Tomography (CT) of abdomen. Though imaging studies are reliable for the diagnosis of acute appendicitis, the cost factor needs to be considered for this along with the radiation exposure to the patient. Also, USG has shown more accuracy while diagnosis acute appendicitis, there remains a factor of operator dependability which can again be a misleading factor for the diagnosis⁵. Imaging studies are not reliable in patients with low and high prevalence of the disease. Because of the lack of reliable imaging methods along with the cost factor, exposure to radiation and operator dependence there is no accurate and effective method which can be applied for the diagnosis of acute appendicitis.

Because of this, many scoring system have been designed which can help in the clinical assessment of the patients who are suspected of acute appendicitis. Scoring system is a method which helps in estimating the probability of having the corresponding disease in a patient which will help in taking accurate decision which can be beneficial to the patient and because of treatment can be started at the earliest. Such scoring system is of a simple design and easy to implement.

There are many scoring systems which are designed for the diagnosis of acute appendicitis. One of the system is Alvarado scoring system which is simple enough to apply and it is effective^{6,7}. This scoring method uses eight variable consisting of total 10 points for acute appendicitis diagnosis. Although this system lacks in certain aspects. Because this scoring system have been prepared, with respect to review of the patients who underwent surgery with suspected diagnosis of acute appendicitis.

- This score doesn't include C- Reactive Protein (CRP) as a variable, even though there is evidence which shows the importance of CRP in the assessment of appendicitis.
- Each variable which is included in the scoring system in statistically and independently relevant to acute appendicitis is not accounted for⁸.

Appendicitis Inflammatory Response (AIR) score was introduced recently which was prepared in the view of the drawbacks in the Alvarado score⁹. This score includes the CRP value in it and this score has been validated on prospective cohort of patients who were suspected of having acute appendicitis. This score contains 2 symptoms, 1 sign and 4 laboratory value. The symptoms to evaluate include nausea, vomiting, anorexia, migration of pain to right lower quadrant, rebound tenderness, muscular defence, body temperature, high which blood cell count, proportion of polymorphonuclear leukocytes and high level of CRP.

These are the variable which are included in the AIR score and different points have been assigned to each variable with maximum score of 12. This score can help in diagnosing appendicitis in the suspected patients who require timely surgery or those who are in need of further evaluation. Also, this score may help in avoiding hospitalisation and unnecessary investigation in those patients in whom appendicitis is unlikely.

This dissertation has been prepared to evaluate the accuracy of AIR score in managing the acute appendicitis and to study the outcome of the scoring system.

Materials & Methods:

STUDY DESIGN: Prospective observational study

Source of data:Total of 130patients admitted to Surgery department in Krishna Hospital & attending surgery opd during the period of December 2020 to June 2022 were taken for study with pain in Right Iliac Fossa with provisional diagnosis of Acute Appendicitis, which are confirmed on USG Abdomen or CT abdomen or Histopathological reports.

Method of collection of data:An informed written consent of the patient was taken and performa of study was explained followed a detailed history and examination.

Conduction of study: Detailed history, demographic data, clinical examination, laboratory investigations, radiological investigations were done. Patient was kept nil by mouth prior to surgery. Patient was shaved and prepared. Informed, valid, written consent for surgery was taken. Patient received preoperative dose of antibiotic. Patient was operated by experienced surgeons. Intra-operative findings were noted. Histopathological reports, post-operative complications and post-operative hospital stay were recorded. Based on all above findings AIRS score was calculated.

Appendicitis inflammatory response score (airs)-

Vomiting	1
Pain in right lower quadrant	1
Muscular defence	
Light	1
Medium	2
Strong	3
Body temperature >38.5 °C	1
Polymorphonuclear leucocytes	
70-84%	1
Equal or more than 85%	2
WBC	
10000-14999 cells/cumm	1
Equal or more than 15000/cumm	2
CRP estimation	
10-49 mg/1	1
Equal or more than 50 mg/1	2

Appendicitis Inflammatory Response Score consists of 2-symptoms, 1-sign and 4- laboratory values.

Variables to evaluate the scoring system include vomiting, pain in right lower quadrant, muscular defence, high body temperature, high white blood cell (WBC) count, proportion of polymorphonuclear leukocytes, and a high level of C-reactive protein (CRP).

These variables are necessary to calculate the AIR score with different points assigned to each variable and maximum score is 12.

If the score is-

1-4 (Low)- Manage the patient on OPD basis and keep follow up were observed for development of acute appendicitis.

5-8 (Intermediate)- In hospital active observation for next 24 Hours and re-evaluation.

9-12 (High)- Surgical exploration.

Results:

Evaluation of AIRS (appendicitis inflammatory response score) scoring system in patients with acute appendicitis.

Table 1: Age distribution of patients (n=130)

Age (in years)	Total no of patients(n)	Percentage of patients (%)
<18 years	33	25.38%
>18 - 30 years	57	43.84%
31-40 years	28	21.54%
41-50 years	12	9.24%
Total	130	100%

Majority of patients 57 (43.84%) fall in >18-30 years, 33 (25.38%) patients in < 18 years, 28 (21.54%) patients in 31-40 years and only 12 (9.24%) patients in 41-50 years. The mean age of the study population was 32.5±11.7. Youngest patient was 9 years old and oldest being 50 years of age.

Table 2: Gender distribution of patients

Sex	Total no of patients(n)	Percentage of patients (%)
Male	76	58.46%
Female	54	41.54%
Total	130	100

In this study male patients 76 (58.46%) were more than female patients 54 (41.53%). The male: female ratio observed in present study was 1.4 :1.

Table 03: Diagnosis among patients:

Ultrasonographic findings	Total no of patients(n)	Percentage of patients
Acute appendicitis	110	84.61%
Probe tenderness	20	15.38%
Total	130	100%

Ultrasound could diagnose appendicitis in 110 (84.61%) patients and 20 (15.38%) patients were found to have only probe tenderness on the ultrasound.

Table 04: Clinical presentation of the patients

Clinical presentation	Frequency	%age
Pain in right lower quadrant	130	100%
Anorexia	110	84.61%
Fever	102	78.46%
Vomiting	84	64.61%
Migrating pain	30	23.07%
Abdominal distension	58	44.61%
Diarrhoea	16	12.30%
Constipation	10	7.7%

Pain in right lower quadrant was present in all patients (100%) out of which migrating pain was present in 30 cases (23.07%), followed by anorexia in 110 patients (84.61%), fever in 102 patients (78.46%) and vomiting in 84 (64.61%) patients. Other symptoms such as abdominal distension in 58 (44.61%) patients, diarrhoea in 16 (12.30%) and constipation in 10 (7.7%) were present.

Table 05: Signs present in the study population:

Signs	Frequency	%age
Guarding	68	52.30%
Tenderness	112	86.2%
Rebound tenderness	92	70.76%
Sluggish bowel sound	60	46.15%
Abdominal distension	18	13.84%
Rigidity	13	10%

It was found that tenderness was most common sign seen and was present in 112 (86.2%) patients, rebound tenderness in 92 (70.76%) patients, guarding in 68 (52.30%) sluggish bowel movement were observed in 60 (46.15%), abdominal distension in 18 (13.84%) and rigidity was seen only in 13 (10%) of the study population.

Table 06: Frequency of signs and symptoms among patients (according to AIRS score)

Signs and symptoms	Frequency	Percentage (%)
Vomiting	84	64.61%
Pain in lower quadrant	130	100 %
Muscular defence	68	52.30 %
Light	30	23.1%
Medium	25	19.23%
Strong	13	10 %
Polymorphonuclear count	98	75.38 %
70-84%	71	54.61%
>85%	27	20.7%
Body temperature >38.5	102	78.46%
WBC Count	62	47.7%
10000-14999 cells/L	35	26.9%
>15000 cells/L	27	20.7%
C reactive protein	70	53.84%
10-49 mg/L	41	31.53%
>50 mg/L	29	22.30%

All patients (100%) had pain in right lower quadrant, 84 (64.61%) presented with vomiting, muscular defence was seen among 68 (52.30%) patients, 98 patients (75.38%) had polymorphonuclear count >70%, 102 patients (78.46%) had body temperature more than or equal

to 38.5 degree, 62 (47.7%) patients had WBC count more than 10,000 cells/L , 70 patients (53.84%) showed CRP more than 10 mg/dL.

Muscular defence was seen among 68 (52.30%) patients out of which 30 (23.10%) patients had light muscular defence, 25 (19.23%) patients had medium muscular defence while only 13 (10%) patients had strong muscular defence.

Total 98 patients (75.38%) had polymorphonuclear count >70%, 71 (54.61%) patients were within the range of 70-84% and 27 (20.7%) of the patients were having count more than 85%.

Total 62 (47.7%) patients had WBC count more than 10,000 cells/L out of which 35 (26.9%) patients had in range of 10,000-14,999 cells/L and 27 (20.7%) patients were having more than 15,000 cells/L.

Total 70 patients (53.84%) showed higher CRP range with 41 (31.53%) patients in the range of 10-49 mg/dL and 29 (22.30%) patients were having CRP more than 50 mg/dL.

Table 07: Histopathological results:

Histopathological findings	Frequency	%age
Acute on chronic non-specific appendicitis	105	80.7%
Necrotising appendicitis	18	13.84%
Perforated appendicitis	7	5.4%
Total	130	100%

Out of 130 patients, 105 (80.7%) patients had histopathological finding of acute on chronic non-specific appendicitis whereas 18 (13.84%) patients showed necrotising appendicitis and only 7 (5.4%) patients had perforated appendicitis.

Table 08: Type of surgical procedure

Type of surgery	Frequency	%age
Open appendectomy	114	87.7%
Laparoscopic appendectomy	16	12.30%
Total	130	100%

Out of 130 patients, 114 (87.7%) patients underwent open appendectomy whereas 16 (12.3%) patients underwent laparoscopic appendectomy.

Table 09: Intra Operative findings:

Intra operative finding	Frequency	%age
Adhesions	70	53.84%
Perforation	9	6.9%
Abscess	27	20.76%
Appendicular fluid	40	30.76%
Gangrenous changes	32	24.61%

The most common intra operative finding was adhesions in 70 (53.84%) patients, second most finding was appendicular fluid in 40 (30.76%) cases, gangrenous changes were found in 32 (24.61%) and abscess in 27 (20.76%) cases whereas perforation in only 9 (6.9%) cases.

Table 10: Distribution of patients as per AIRS score

Score	AIRS	Percentage (%)
≤4	27	20.76%

5-8	67	51.53%
>8	36	27.69%
Total	130	100%

Maximum number of patients 67 (51.53%) were present in AIRS score range of 5-8, followed by 36 (27.69%) patients having score >8 and only 27 (20.76%) patients with score <4.

Table 11: Average duration of hospital stay among study population

AIRS score	No of post operative days	Percentage of patients (%)	P value
<4	7.2 days	23%	<0.05 statistically significant
5-8	10.7 days	49%	
>8	13.9 days	28%	

In our present study due to severity of the cases, longer post-operative stay in hospital was the most important factor contributing to the morbidity. It was the more in patients with AIRS score >8 (13.9 days) as compared to patients with score 5-8 (10.7 days) and score <4 (7.2 days). The findings were statistically significant at the p value <0.05.

Table 12: Post-operative complications:

Post op complications	<4	5-8	>8	P value
Fever	5 (18.51%)	18 (26.86%)	36 (100%)	<0.05 statistically significant
Wound discharge	Nil	8 (11.94%)	22 (61.11%)	
Wound dehiscence	Nil	3 (4.4%)	17 (47.22)	
Respiratory tract infection	Nil	2 (2.9%)	9 (25%)	
Diarrhoea due to post- op pelvic collection	Nil	Nil	2 (5.6%)	

It was found that majority of post-operative complications were there in the group with AIRS score >8. All patients (100%) of this group reported fever during post-operative period followed by 22(61.11%) patients reported discharge and 17 (47.22%) patients had wound dehiscence where as in other two groups comparatively less post-operative complications were reported. The findings were statistically significant at the p value <0.05.

Discussion:

Appendicitis Inflammatory Response score is a scoring system developed to assess the health status of the patient with acute appendicitis. The present study assesses the role of AIRS scoring system in patients with acute appendicitis.

In this study total 130 patients were included. It was observed that majority of the patients were in the age group of 18-30 years with 57 patients (43.84%) followed by <18 year age group having 33 (25.38%) patients and 31-40 years with 28 (21.53%) patients. The patients in the age of 41-50 years were relatively less with only 12 (9.23%). There was predominance of the patients who were diagnosed with acute appendicitis in the age group more than 18 years whereas in the group of less than 18 years there were comparatively less patients. Total 97 (74.61%) patients out of 130 were above 18 years and only 33 (25.38%) were below 18 years. The mean age of the study population was 32.5±11.7. Youngest patient was 9 years old and oldest being 50 years of age. In

the present study there was male predominant in the acute appendicitis patients with 76 patients (58.46%) out of 130 being males whereas 54 patients (39.23%) were females. The male: female ratio was 1.4: 1. In the study done by Tony Jose et al, included total 130 patients. Similar to our study there was predominance of the male patients with total 77 (59.23%) males and 53 (40.76%) females who underwent appendectomy for the acute appendicitis. The age range in this study was found to 12-70 years with mean age 27.5 ± 13.3 year. In another study done by Suresh Patil et al, similar to our study it was observed that out of total 100 patients included in the study 11 patients were below 18 years of age whereas 89 patients were above 18. And there was male predominance in the study with total 65 (65%) males and 35 (35%) females. The age range of the study population was 9-72 years with mean age of 28.9 ± 13.89 years.

During the investigation and evaluation of the patients it was also noted that out of 130 patients 110 patients (84.61%) were actually diagnosed with acute appendicitis on ultrasonography whereas rest of the patients, 20 patients (15.38%) were having only probe tenderness though later it was diagnosed that all the patients were actually having acute appendicitis. In the study by Suresh Patil et al, as well similar findings were observed that out of total 100 patients 80 (80%) patients were diagnosed with acute appendicitis on the ultrasound whereas 20 (20%) patients were diagnosed as probe tenderness on ultrasound.

All the patients were clinically examined for signs and symptoms. Pain in right lower quadrant was present in all patients (100%) out of which migrating pain was present in 30 cases (23.07%), followed by anorexia in 110 patients (84.61%), fever in 102 patients (78.46%), vomiting in 84 (64.61%) patient and abdominal distension in 58 (44.61%) patients was present. The percentage of diarrhoea and constipation was less in the study population. Also it was noted that certain signs related to acute appendicitis were present among the study population. Most common sign found was tenderness in 112 (86.2%), rebound tenderness in 92 (70.76%) patients, guarding in 68 (52.30%), sluggish bowel movement were observed in 60 (46.15%), abdominal distension in 18 (13.84%) and rigidity was seen only in 13 (10%) of the study population. In the study by Suresh Patil et al, anorexia was the most common symptom observed in the study population which was present in 99 patients followed by vomiting in 79 patients and 96 patients experienced pain in right lower quadrant whereas there was migrating pain present in 17 patients and rebound tenderness was present in 75 patients. Also in guarding and leucocytosis was seen 40 and 61 patients respectively. There was difference seen in the present study and literature where anorexia was most common symptom in literature whereas pain in right lower quadrant was the most common symptom followed by anorexia in the present study.

During the scoring of the patients in the present study- all patients (100%) had pain in right lower quadrant. Vomiting was seen in 84 (64.61%). Muscular defence was seen among 68 (52.30%) patients which was distributed according to its severity. 30 (23.10%) patient had light muscular defence, 25 (19.23%) patients had medium muscular defence while only 13 (10%) patients had strong muscular defence. Polymorphonuclear count was also measured in the study population which was divided into two groups, 70-84% and more than 85%. Total 98 patients (75.38%) had polymorphonuclear count $>70\%$, 71 (54.61%) patients were within the range of 70-84% and 27 (20.7%) of the patients were having count more than 85%. Total 102 patients (78.46%) had body temperature more than or equal to 38.5 degree. Total 62 (47.7%) patients had WBC count more than 10,000 cells/L out of which 35 (26.9%) patients had in range of 10,000-14,999 cells/L and 27 (20.7%) patients were having more than 15,000 cells/L. Total 70 patients (53.84%) showed higher CRP range, with 41 (31.53%) patients in the range of 10-49 mg/dL and 29 (22.30%) patients were having CRP more than 50 mg/dL.

Patients were analysed according to the AIRS scoring system and were distributed according to the scoring the patients get. Scoring was divided into three groups that is <4 , 5-8 and >8 . Out of 130 patients majority of the patients were found in the score of 5-8 with 67 (51.53%) patients. It was followed by 36 (27.69%) patients having AIRS score >8 and only 27 (20.76%) patients with score <4 . This suggests the accuracy level of the AIRS score to diagnose the severity of the acute appendicitis in the study population. In study done by Suresh Patil et al, similar to our study out

of total 100 patients total 73 (73%) patients had score between 5-8 whereas 16 (16%) patients had score less than 4 and 11 (11%) patients with score more than 8.

All the cases included in the present study were diagnosed acute appendicitis cases therefore all the patient underwent surgery. Out of 130 patients total 114 (87.7%) patients underwent open appendectomy whereas 16 (12.3%) patients underwent laparoscopic appendectomy.

During the surgery some intraoperative findings were observed. The most common finding was adhesions in 70 (53.84%) patients, second most finding was appendicular fluid in 40 (30.76%) cases, abscess in 27 (20.76%) cases and gangrenous changes were found in 32 (24.61%) cases whereas perforation in only 9 (6.9%) cases.

It was also noted that post-operative complications were found to be less in the patients who had AIRS score less than 4 with only post-operative complication seen was fever in 5 patients. Whereas in patients with score 5-8 and >8 it was observed that there was presence of wound discharge, wound dehiscence, respiratory tract infection and collection of fluid in the pelvic region which led to diarrhoea. Such complication were nil in the patients with AIRS score less than 4. The findings were statistically significant at the p value <0.05.

Histopathological examination of the study population was also done in which it was found that 105 (80.7%) patients had histopathological finding of acute on chronic non-specific appendicitis whereas 18 (13.84%) patients showed necrotising appendicitis and only 7 (5.4%) patients had histopathological finding of perforated appendicitis. In study by Suresh Patil et al, total 89 cases were found to have acute appendicitis whereas 11 cases were diagnosed with chronic appendicitis on histopathological examination. This is another difference found in the present study and the literature.

Also average hospital stay was analysed in the patient who were graded according to the AIRS scoring. The average duration of hospital stay was only 7.2 days in the patients with AIRS score <4 whereas it was 10.7 days and 13.9 days in the patients with AIRS score of 5-8 and >8 respectively. The findings were statistically significant at the p value <0.05.

This was suggestive of the accuracy of the AIRS score in predicting the post-operative outcome such as post-operative hospitalization and post-operative complications.

Conclusions:

AIRS aided in accurate diagnosis of acute appendicitis which can help in taking correct decision regarding the therapeutic approach to manage the patient surgically. AIRS has incorporated the C-reactive protein value in it and can be used by clinicians in daily practice to efficiently diagnose and manage patients with acute appendicitis, being simple to apply and cost effective. Also AIRS evaluation showed that, the patients with low AIRS score had better health outcomes compared to higher score such as post-operative hospital duration of stay, post-operative complications. Therefore it can be concluded from the present study the AIRS scoring system can help in improving the overall health outcome of the patient due to correct management of the patients.

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