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Evaluation of the Appendicitis Inflammatory Response Score for Patients with suspected Acute Appendicitis

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Abstract
Introduction: *Acute appendicitis is one of the commonest surgical emergencies. Simple appendicitis can progress to perforation, which is associated with a much higher morbidity and mortality. The study has been undertaken to evaluate the efficacy of Appendicitis Inflammatory Response Score in diagnosis of acute appendicitis and its correlation with operative and histopathological findings and to review its usefulness in cutting down the rate of negative appendectomy without increasing morbidity and mortality.*
Methodology: *A study of 100 patients presenting with pain abdomen suspected to be of acute appendicitis was undertaken. Initially all the patients were examined by surgical team and a decision to operate was taken depending on clinical impression. After that Appendicitis Inflammatory Response Score was calculated for each patient individually. The efficacy of score was evaluated on the basis of sensitivity, specificity, positive predictive value and negative appendectomy rate after comparison of the score with the histopathological report.*
Results and Observation: *The overall sensitivity of Appendicitis Inflammatory Response Score score at score > 4 was found to be 89.9% and the overall specificity at score > 8 was found to be 100%.*
Conclusion: *The AIR score is a fast, simple, reliable, non-invasive, repeatable and safe diagnostic modality without extra expense and complications*
Keywords: *Suspected Acute Appendicitis, Efficacy of Appendicitis Inflammatory Response Score.*

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I. Introduction

Appendicitis today is the most common reason for emergency abdominal surgery and has a lifetime risk of 7-8%[1]. It is a disease more commonly seen in the younger population with a slight male preponderance. Its incidence rises slowly from birth and peaks in the late teen years, while gradually declining in the elderly age group[2]. 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. Acute appendicitis is essentially a clinical diagnosis[3]. Routine history and physical examination still remain the most practical diagnostic modalities. Absolute diagnosis of course is only possible at operation and histopathological examination of the specimen[4].

Scoring systems are valuable and valid instruments for discriminating between acute appendicitis and non-specific abdominal pain[5]. The Appendicitis Inflammatory Response Score is a newly developed diagnostic tool that uses seven scored variables to stratify patients into Low, Intermediate, and High-risk groups. That has been validated and found to outperform the older Alvarado's Score[6,7]. This may be because the Appendicitis Inflammatory Response Score relies on less subjective symptoms such as anorexia or nausea, includes C-reactive protein[8] and employs graded parameter compared with the dichotomized variables in the Alvarado's Score[9]. This study is to evaluate the efficacy of Appendicitis Inflammatory Response Score in the diagnosis of acute appendicitis and its correlation with operative and histopathological findings and to review its usefulness in cutting down the rate of negative appendectomy without increasing morbidity and mortality.

II. Materials And Method

After institutional ethical committee clearance and written informed consent from patients, this observational prospective study was conducted comprising of 100 patients with suspected acute appendicitis attending the department of general surgery between Jan 2016 to June 2017. Suspected acute appendicitis was defined as "acute onset (≤ 1 week), non-traumatic right lower quadrant pain consistent with the diagnosis of

acute appendicitis". All the patients were initially examined by the on duty surgical team and a decision was made based entirely on the clinical impression of the surgical team. After the documentation of the clinical impression, all the patients were further examined and investigated and Appendicitis Inflammatory Response Score was calculated for each patient and were grouped into three groups. Patients having Appendicitis Inflammatory Response Score between (0-4) were grouped into low, between (5-8) were grouped into intermediate and between (9-12) were grouped into high-risk group. All patients undergoing appendectomy, their appendix was sent for histopathological examination and the diagnosis of acute appendicitis was established only after histopathological examination as described by Carr[10] and will be strictly defined by "the presence of a transmural neutrophilic infiltration".

We used 38.5^{o}C or higher, to make it comparable to fevers in other studies that defined fever as body temperature (axillary) ≥ 38^{o}C[11]

According to severity tenderness was divided into light, medium and strong on the basis of soft tissue tenderness grading scheme by Hubbard DR &Berkoff GM 1993[12]. For our study purpose, grade 1 was considered light, grade 2 was considered medium and grade 3 & 4 was considered strong.

For the evaluation of AIR score Sensitivity, Specificity & Positive Predictive Value were calculated.

Appendicitis Inflammatory Response Score (AIRS)[6] :

This scoring system consists of 2 symptoms, 1 sign and 4 laboratory values as follows:

AIR Score Variables	Score
Vomiting	1
Pain In Right Lower Quadrant	1
Rebound Tenderness (or muscle guarding)	
Light	1
Medium	2
Strong	3
Body Temperature (>38.5˚C)	1
Polymorphonuclear Leucocytes	
(70-84) %	1
≥85 %	2
White Blood Cell Count	
(10,000-14,999) cells/cumm	1
≥ 15,000 cells/cumm	2
C-Reactive Protein Estimation	
(10-14) mg/l	1
≥ 50 mg/l	2

Table 1: AIR Score

Inclusion Criteria:

All patients admitted to the department of general surgery with a diagnosis of suspected acute appendicitis.

Exclusion Criteria:

- Age < 10 years or > 60years
- History of trauma to abdomen in the last 7 days
- Pregnant women
- Associated co-morbidities like Diabetes Mellitus, Hypertension, Ischaemic Heart Disease and Chronic Obstructive Pulmonary Disease.
- Patients with Immuno-compromised state.

Plan for analysis of data:

Statistical software mainly SPSS 11.0 and Systat 8.0 was used for the analysis of the data and Microsoft Word & Excel were used to generate graph and tables, etc.

III. Result And Observation

Statistical analysis of observations and results of the study is presented in tabular form**.**

Table 2: Gender wise distribution of appendicitis patients

	No of patients	Appendicitis	Overall Percentage
Male	65	61	68.5 % (61/89)
Female	35	28	31.5 % (28/89)
Total	100	89	-

Gender wise distribution of appendicitis patients: Appendicitis is more common in males.

Table 3: Age wise distribution of appendicitis patients.

Groups	Percentage of patient
All patient having appendicitis	89.0% (89/100)
Appendicitis patients ≤ 30yr	78.6% (70/89)
Male appendicitis patient ≤ 30yrs	78.7% (48/61)
Female appendicitis patient ≤ 30yr	78.6% (22/28)

Age wise distribution of appendicitis patient: Appendicitis is more common in younger age group. Approximately 78.6% of patients having appendicitis were < 30 years of age.

Table 4: Percentage of appendicitis patients having various signs

Signs	Percentage of appendicitis patient
McBurney's point tenderness	79.77 % (71/89)
Rebound tenderness	44.9 % (40/89)

Tenderness at McBurney's point is the most common sign. Rebound tenderness is present in 44.9%.

Table 5: Percentage of patients having leucocytosis in different groups

Groups	Patient having leucocytosis
Total study population	64.0 %
All appendicitis patient	63.0 % (56/89)
All male appendicitis patient	62.3 % (38/61)
All female appendicitis patient	64.3 % (18/28)

Leucocytosis is found in 63% of appendicitis patients.

Out of the 100 patients 94 were operated of which 89 were found to have acute appendicitis whereas 5 patient underwent negative appendectomy on the basis of clinical impression of the on duty surgical team.

Table 6: Distribution of total study population into various risk group on the basis of Appendicitis Inflammatory Response Score

AIR score based risk group	No. of patients
Low(1-4)	16
Intermediate (5-8)	73
High (9-12)	11

Maximum patients were in the intermediate risk group on the basis of Appendicitis Inflammatory Response Score.

Table 7: Sensitivity, Specificity, PPV & NPV of AIR score at different score values

Statistical Values	AIR score >4	AIR score >8
Sensitivity	89.9%	12.3%
Specificity	63.6%	100%
Positive Predictive Value	95.23%	100%
Negative Predictive Value	43.75%	12.3%

It is found that Appendicitis Inflammatory Response Score had a sensitivity of 89.9% at score >4 and specificity of 100% at score >8 respectively.

Table 8: Comparison of Negative Laparotomy Rate.

	Clinical Finding	AIR score>4	AIR score >8
Negative Laparotomy Rate (NLR)	5.31% (5/94)	4.76 % (4/84)	0% (0/11)

The Negative Laparotomy Rate is 4.76% at score > 4.

IV. Discussion

The present study was undertaken to evaluate the usefulness of Appendicitis Inflammatory Response score in reducing the number of negative appendectomy and to evaluate its sensitivity, specificity& positive predictive value in the diagnosis of acute appendicitis. Our results and observations were discussed and compared with various other studies.

In our study appendicitis is more common in males (68.5%) compared to females (31.5%), this is consistent with the study conducted by Baralas Sulu et al[13] in which appendicitis was more common in males (53.5%) compared to females (46.5%).

Maximum cases of appendicitis is found to occur in ≤ 30years of age (78.6%). This is consistent with the study conducted by A J Scott et al[14] in which the mean age of appendicitis was found to be 27 years

The most common symptom observed is vomiting (apart from pain), which is found in 77.5% of appendicitis patient. This is higher to the findings of H Kariman et al[15] in which 61% of individuals were found to have nausea and vomiting.

Temperature is raised in 64 % of appendicitis patient. Similar findings were also noted by Lin et al[16] in which the frequency of fever in appendicitis group was comparatively higher than the non-appendicitis group (43.4% vs 17% respectively)

On clinical examination, tenderness at McBurney's point is the commonest sign. Rebound tenderness was present in 44.9% of individuals having acute appendicitis. The sensitivity being 44.9%. A higher percentage of patients were found to have rebound tenderness in a study conducted by Yashwant RL et al[17], in which the sensitivity of rebound tenderness was found to be 65.1%.

Leucocytosis in this study was found to be 63% which is comparable with the results of Kim BS et al[18] in which 72% of appendicitis patients had leucocytosis.

C-reactive protein demonstrated a sensitivity of 86.5% and specificity of 63.63% in the present study. A recent meta-analysis has shown that there is fivefold increase in the positive likelihood ratio for acute appendicitis when both WBC count and C-reactive protein are elevated[19,20].

Table 9: Sensitivity, Specificity & Positive Predictive Value of AIR score.

	AIR Score	
Score	>4	>8
Sensitivity	89.9 %	12.3 %
Specificity	63.6 %	100 %
Positive Predictive Value	95.2 %	100 %

In our series an attempt was made to evaluate the efficiency of Appendicitis Inflammatory Response Score on the basis of sensitivity, specificity and positive predictive value as shown in the above table.

Table 10: Comparison of present study with various other studies.

	Sensitivity		Specificity	
	AIRS>4	AIRS>8	AIRS>4	AIRS>8
Malyar et al[21]	97%	12%	77%	100%
Sudhir and sekhar[22]	78.43%	33.33%	89.8%	97.96%
Scott et al[14]	90%	-	-	97%
Castro et al[7]	93%	10%	85%	100%
Present Study	89.9%	12.3%	63.6%	100%

Sensitivity of AIR score of 89.9 % (at score >4) in the present study correlates well with studies of Castro et al[7] (93 %). However the specificity of Appendicitis Inflammatory Response Score (63.6% at score >4) is comparatively lower compared to Castro et al[7] (85%). This may be due large number of study population in the series conducted by Castro & others (Total study population=941) leading to a more precise estimation of specificity of Appendicitis Inflammatory Response Score.

Table 11: Comparison of Negative Laparotomy Rate.

	AIR score>4	Clinical Finding	p-value
Negative Laparotomy Rate (NLR)	3.6 % (3/84)	5.31% (5/94)	0.86

The overall negative laparotomy rate (NLR) in our series was found to be 5.31 % (5/94) on the basis of clinical impression of the surgical on call team, which could be further improvised by the use of Appendicitis Inflammatory Response Score in which case the negative laparotomy rate would have been (3/84= 3.6%) but this difference is statistically not significant (p=0.86).

One important point to be noted is that when we combine the findings of clinical impression of the surgical team and appendicitis inflammatory response score in the management of suspected acute appendicitis patients, the overall negative laparotomy rate can still be further reduced to 2.41% (2/83) but a greater number of patients (in this study 8) having appendicitis would have been missed. Thus Appendicitis Inflammatory Response Score cannot be used in the diagnosis of acute appendicitis rather it can only be used as a complementary aid in the diagnosis of acute appendicitis when there is obvious confusion in the diagnosis.

The universal negative appendectomy rate is (15-30) %. The low negative laparotomy rate obtained in our study may be due to delay in reaching the hospital from peripheral areas which makes the clinical picture of acute appendicitis more clear. Thus a prompt referral system and a larger study group would help in better estimation of the negative laparotomy rate in a more precise way.

V. Summary

- In the present study 65% of patients were males and 35% were females.
- 78.6% of appendicitis patients were ≤30 years of age.
- Temperature is raised in 64% of appendicitis patient.
- Total leucocyte count is elevated in 63% of appendicitis patient.

- Histopathological examination of the resected appendix proved acute supurrative (66.29%) and acute gangrenous (19.10%) type to be predominant.
- The sensitivity of Appendicitis Inflammatory Response Score is 89.9% at score>4 and specificity is 100% at score>8.
- The positive predictive value of scoring system is 95.23% at an AIR score of >4.
- The negative appendectomy rate in this study is 4.76% at an AIR score of >4.

VI. Conclusion

- Appendicitis Inflammatory Score has high sensitivity and Positive Predictive Value at an AIR score of more than 4 in the diagnosis of acute appendicitis.
- The application of this scoring system improves diagnostic accuracy and consequently reduces negative appendectomy rate.
- In the diagnosis of acute appendicitis AIR score is a fast, simple, reliable, non-invasive, repeatable, safe complimentary aid without extra expense and complications.
- It is very handy in day care hospitals or peripheral hospitals where back up facilities like USG scan or CT scan is not available all the time.

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