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In the era of CT, modified Alvarado score reduces the risk of negative appendectomy in low socioeconomic region?

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Abstract
Acute appendicitis is the most common abdominal surgical emergency in the world with an incidence of 96.5 to 100 per 100,000 adults. The clinical diagnosis is based on history, clinical examination, laboratory evaluation and imaging. In the era of CT scan negative appendectomy has been around 15-25% and considerably higher rate especially in women. In this study we have taken 216 patients of suspected acute appendicitis from the department of surgery during the year 2019-2021. We applied the Modified Alvarado score to these patients. Those patients with a modified Alvarado score >= 8 were taken for the open appendectomy surgery irrespective of ultrasonography \CT findings. Of them 200 patients had Modified Alvarado score above 8. Of which tissue diagnosis was confirmed in 176 patients. Among which we found 112 were male patients and 88 were females. Acute appendicitis was found on h/p reports in 88% of the patients with a score of more than 8. Only 12% of patients were found to have other pathology or normal appendix.

Keywords: Modified Alvarado score, Low socio-income state, acute appendicitis negative-open appendectomy rate.

1. Introduction
Acute appendicitis is the most common cause of surgical acute abdomen and the most commonly performed surgery worldwide. Computed tomography scan is the gold standard diagnosis method for acute appendicitis. But the role of clinical diagnosis is inevitable especially in settings of low social income states as of Odisha and developing countries as India. The lack of logistics, modern diagnostic methods and affordability by the community plays a major role in health access in various clinical and emergency settings.

In an Indian state such as Odisha, being one of the low socio-economic regions and with a high patient burden on tertiary hospitals such as SCB medical college, there is a huge difference in number of patients needing various diagnostic methods and those getting them on time. The dependability on clinical diagnosis can be considered more in such situations based on the classical scoring system described by Dr Alfred Alvarado. Our study was conducted in the department of general surgery SCB medical college Cuttack, Odisha during the period of Jan 2019-Jan 2020.

2. Aims and Objective
2.1. To calculate the accuracy of diagnosis of acute appendicitis by using modified Alvarado score in suspected cases of acute appendicitis irrespective of imaging studies.
2.2. To evaluate the percentage of patients with actual tissue diagnosis of acute appendicitis after conducting open appendectomy and HPE report.
2.3. To calculate the rate of negative open appendectomy in our study and the difference in male and female patients.
2.4. To compare the rate of negative open appendectomy with previous studies.

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3. Materials and methods

The study was conducted in Department of General surgery of SCB Medical college and hospital Cuttack in collaboration with Department of Pathology of the same institution during the period of Jan 2019- 2020. Out of 7734 patients admitted to Surgery Department, 492 were suspected cases of acute appendicitis based on history and clinical findings. Out of these 216 patients were randomly selected to apply Alvarado score.

3.1 Inclusion criteria

a) Patients coming to the department of surgery or emergency room with a history of acute onset right lower quadrant pain or peri-umbilical pain, history of fever vomiting, nausea.
b) Patients of all age were included in the study irrespective of gender.
c) Patients willing to take part in the study after proper explanation and consent.

3.2 Exclusion criteria

a) Patients previously diagnosed with appendicitis.
b) Patients with preference of laparoscopic surgery after proper information and explanation.
c) Patients with long standing right lower quadrant pain or other chronic illnesses in their medical or surgical history.
d) Patients not choosing to take part in the study.

Name, age and sex of the patient were recorded and they were serially numbered to according to the date of admission.

3.3. Establishment of diagnosis

A detailed history was taken in cases with special reference to the relevant points. Pain, anorexia, nausea, vomiting and temperature. Past history of any such episodes, previous surgeries and bowel habits were also recorded. Family history and gynecological history in females were also taken.

3.4. Modified Alvarado Scoring

Each patient was scored using modified Alvarado scoring system.
Patient with a total score of 1-4, were ruled out the diagnosis of acute appendicitis and kept for observation and conservative management.
Patients with a score of 5-6, were considered to have a possible diagnosis of acute appendicitis but not convincing to warrant immediate surgery were kept for further review.
Patients with a score of 7-8 probable diagnosis of acute appendicitis were considered, and rescored after close monitoring.
Those patients >=8, were diagnosed as having a diagnosis of acute appendicitis were considered for open appendectomy irrespective of ultrasound findings. These patients were included in the study.
All the scoring was done before any imaging study as USG/CT scan to avoid bias.

3.5. Operative management

The chosen patients with score >=8 underwent open appendectomy was done. During exploration appendix was carefully checked for morphological changes.

Histopathological examination of all the resected appendices were done to confirm the diagnosis of acute appendicitis.

3.6. Post operative management and follow up.

The patients were discharged and adequate follow up was done. And they were followed up any for late complications.

4. Observations

Out of 492 patients admitted to surgery department of SCB medical College and hospital, Cuttack. 216 patients were selected randomly to apply Alvarado Score. Out of these 200 patients scored above 8 and only these patients were included in the study group and were subjected to laparotomy. The rest of the patients were treated conservatively.

5. Results & Discussion

The primary aim of this study was to evaluate the efficacy of modified Alvarado score in reducing the negative open appendectomy rate by improving clinical diagnosis in patients irrespective of imaging findings. The implications were discussed and results of previous study were compared with our results. Acute appendicitis has been found most frequently in 10-30 yrs age group. [1,2]
Coming to the statistical data collected from our department of Radiology SCB medical college over a 12 months and mean value for a month was calculated as below:
Number of ultrasonography examination done per month = 2,594
Number of cases with diagnosed acute appendicitis/ appendicular perforation/ subacute appendicitis through USG abdomen and pelvis= 27
Total number of CECT used for suspected cases of appendicitis =3
Number of open appendectomies conducted =26
Number of laparoscopic appendectomy conducted = 18
Our study showed males more than females among clinically and histologically diagnosed acute appendicitis. [1,2,3] Pain has been reported the earliest symptom and the most constant complaint in patients of acute appendicitis.[1,2] Whereas as our study showed RIF (right iliac fossa pain) in 21% of cases.(13% of cases; Lewis et al)
Alvarado score system was developed by Alvarado A in 1986 based on 3 symptom and 3 signs and 2 laboratory findings.[4] In our study group, the diagnostic accuracy was 88%(n=200). The diagnosis was more accurate among males (91%) than in females (84.1%). The results with other authors were similar for instance, Macklin CP et al 88.3% [5]. MAR Fallouji had an accuracy of 97 % [6].
Among the disorders that mimicked appendicitis were tubo-ovarian mass in females and peptic perforation and Meckel's diverticulitis in males i.e 28.6%(n=4) and 40% (n=4) respectively. [1,2] A definite pathology was found only in 8 no of cases non-appendicitis (33.3%), however in remaining cases (16) i.e 66.7 of non-appendicitis cases we did not find any pathology. In our study the negative appendectomy cases rate was reduced from 20.3% to 12%.
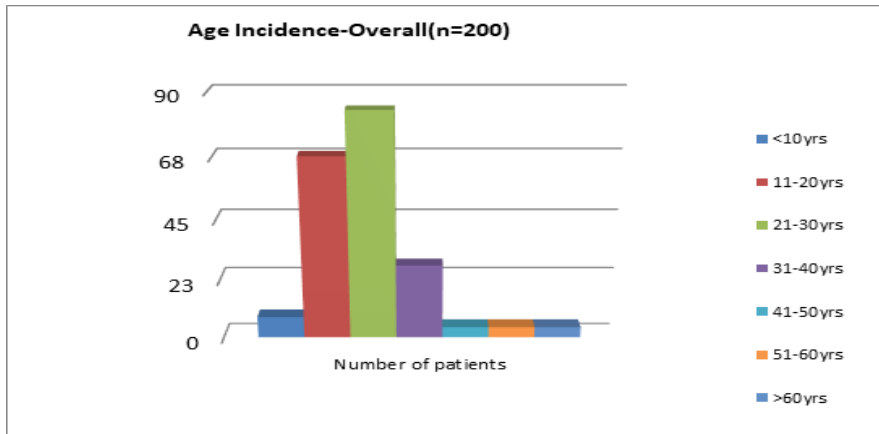[]

6. Tables and Figures

Fig.6.1 People in different age groups diagnosed with acute appendicitis.

Table.1: Number of people in different age group diagnosed with acute appendicitis.

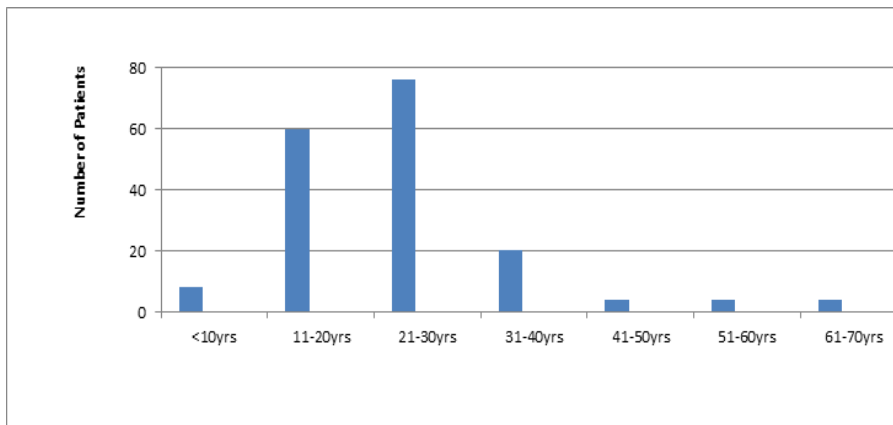| Age group(yrs)	Number of patients	Percentage
<10	08	4.00
11-20	68	34.00
21-30	84	42.00
31-40	28	14.00
41-50	04	2.00
51-60	04	2.00
>60	04	2.00

Fig. 6.2 Age incidence of histologically proven cases.

Table 2: Age incidence of histologically proven cases of acute appendicitis.

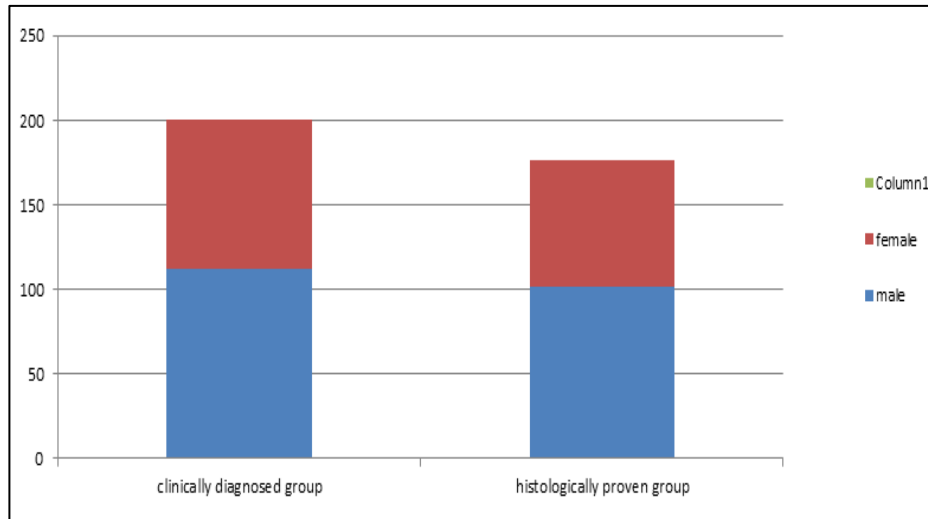| Age group(yrs)	Number of patients	Percentage
<10	8	4.50
11-20	60	34.10
21-30	76	43.20
31-40	20	11.40
41-50	4	2.30
51-60	4	2.30
>60	4	2.30

Fig.6.3 This shows the sex ratio of male and females with diagnosed and proven appendicitis.

Table 3: This table calculates the sex ratio in our study.

	Male	Female	Sex ratio (M: F)
Clinical Appendicitis group(score>8)	112	88	1.27
Histolsogically proven group	102	74	1.38

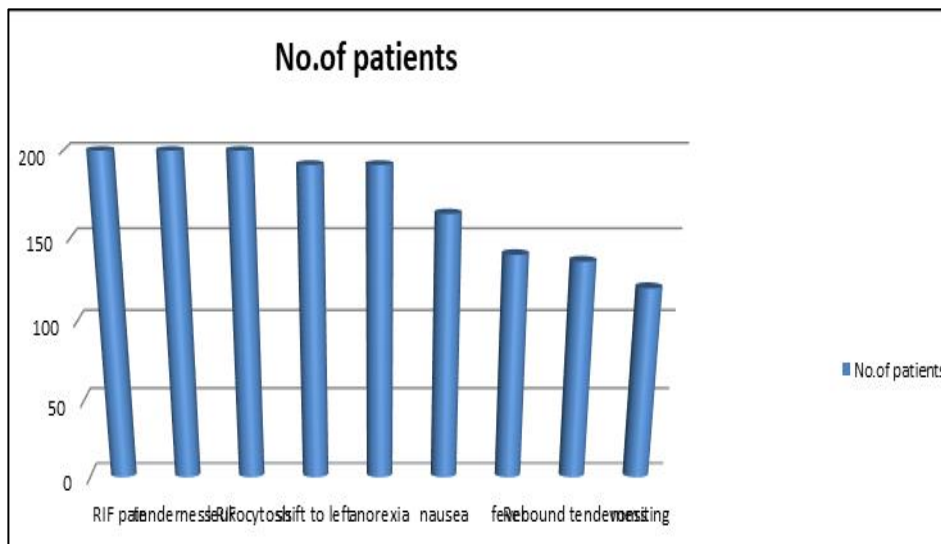**Fig 6.4:** The bar diagram shows the number of patients having various Alvarado parameters among the nine parameters.

Table 4: Table showing the number of patients having various Alvarado parameters.

Symptoms	No of patients	Percentage
Right iliac fossa pain	200	100
Tenderness RIF	200	100
Leukocytosis	200	100
Anorexia	192	96
Shift to left	192	96
Nausea	164	82
Vomiting	120	60
Rebound tenderness	136	68
Fever	140	70

Fig.5.1: Intraoperative image of acute appendicitis during open appendectomy by McBurney incision.

7. Summary

Out of 492 cases 216 patients were examined randomly and evaluated by using Alvarado score. 200 patients who scored above 8 were diagnosed clinically as acute appendicitis were subjected to open appendectomy via mc Burney incision. of the 200, 112 were male and 88 were female patients. Out of 200, 176 patients showed HPE report suggestive of acute appendicitis (Diagnostic Accuracy=88%). Addition of ultrasound as diagnostic tool does improve the accuracy in patients with a negative or equivocal Alvarado score particularly female to exclude other intra-abdominal pathology and markedly reduces the negative appendectomy rate. the series showed us a decrease of Negative appendectomy rate to just 12% compared to 20.3% in previous studies. The study not only suggests avoidance of unnecessary investigation like USG, CT scan but also helps us in timely intervention in patients with high Alvarado score.

8. Appendix

The collective data used from the patients and lab findings was used to make this complete table for our study.

9.1 Patient demographic data:

Sl no.	Name(initials)	Age(yrs)	Admission detail	sex

9.2 Symptomatology Data collected from our patients:

Pain duration (hr)	Recurrent pain	Pain RIF	Anorexia	Nausea	Fever	Tenderness RIF	Rebound Tenderness	WBC count	Total Alvarado score

9.3 Management and follow up:

Operative finding	Histopathology	Complication (if any)	Follow up

9. Acknowledgments

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