

Comparison of Modified Alvarado and RIP ASA Score as Diagnostic Tool for Acute Appendicitis in Different Sex and Age Groups: A Prospective Study among Rural Population of West Bengal

Subhendu Bikas Saha¹, Subir Kumar Majumdar², Rajarshi Gayen³, Biswaprakash Nandy⁴, Pranoy Ghosh⁵

¹Associate Professor, Department of General Surgery, Midnapore Medical College, Midnapore, West Bengal, India.

²Associate Professor, Department of General Surgery, Midnapore Medical College, Midnapore, West Bengal, India.

³Assistant Professor, Department of General Surgery, Midnapore Medical College, Midnapore, West Bengal, India.

⁴Senior Resident, Department of General Surgery, Midnapore Medical College, Midnapore, West Bengal, India.

⁵Junior Resident, Department of General Surgery, Midnapore Medical College, Midnapore, West Bengal, India.

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Corresponding Author: Dr. Biswaprakash Nandy

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Abstract:

Background: Diagnosis of acute appendicitis (AA) is often confusing, leading to delay in diagnosis and negative appendectomies. To solve the problem, several scoring systems, commonly Modified Alvarado Scoring System (MASS) and RIPASA score (Raja Isteri Pengiran Anak Saleha Appendicitis score) had already been studied. Diagnostic accuracy(DA) of the former is lower than the later. Although, AA is a disease of mostly young with slight male dominance, it can affect all age groups. The negative appendectomy rate (NAR) is challenging particularly in young females. We intend to study gender-specific and age-group specific comparison of the above two scoring systems in our rural Indian patients, for which available literatures are quite scanty till date.

Methods: The present study was conducted in the department of General Surgery, Midnapore Medical College, Paschim Medinipur, West Bengal, India. We prospectively studied 160 patients with right iliac fossa pain; categorized into three agegroups, namely Group I- less than 15 years, Group II- 15 to 60 years and Group III- more than 60 years. Two Scoring methods were applied to all patients. Acute appendicitis was confirmed by histopathology.

Results: Our study revealed much lower NAR using RIPASA score particularly in females of all age groups (10.41% versus 14.6% in males). The DA of MASS and RIPASA were 72.22 versus 91.66% in Group I, 57.14 versus 74.60% in Group II and 64 versus 72% in Group III respectively.

Conclusions: RIPASA score is more convenient and accurate than MASS, not only in females but also in all age groups, especially in young patients in rural Indian population.

Keywords: Acute Appendicitis, Modified Alvarado Score, RIPASA Score.

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Introduction

Acute appendicitis (AA) is one of the most common surgical emergencies in clinical practice, with an estimated lifetime prevalence rate of approximately one in seven. Incidence of AA ranges from 1.5 to 1.9 per thousand in general population with 1.4 times higher rate in men than women and the diagnosis is based mainly on clinical history and examination combined with laboratory investigations such as elevated white cell count. [1,2]

Diagnosis of AA sometimes become challenging, particularly in children and young females of reproductive age groups. [3-9] Delay in timely diagnosis leads to many complications culminating in alarming morbidity and mortality. [5,10] In fact, this condition is a double edged sword; if under-diagnosed, it can lead to complications like perforation, peritonitis and if overdiagnosed, the incidence of negative appendectomy rate (NAR) can rise, putting an economical burden on health resources and the patients as well. [11] So accurate

diagnosis and timely intervention of acute appendicitis is essential to avoid complications. [3] Several scoring systems such as Alvarado (1986), modified Alvarado(1994), Tzanaki's(2005), Appendicitis Inflammatory Response (AIR)(2008), Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score(2010) and Adult Appendicitis Score (2017) had been evolved over the time aiming correct early diagnosis of acute appendicitis. [5,6,12-17]

Although diagnostic accuracy (DA) can be increased through use of ultrasonography (USG), computed tomography (CT) imaging and diagnostic laparoscopy; these modalities are costly and may not be easily available at emergency hours and in rural set up. [3-5,10,12] A recent study disfavoured indiscriminate use of CT and pointed out that it may lead to delay in treatment and unnecessary appendectomies. [18] As per published update (April 2020) of Jerusalem guidelines, by World Society of Emergency Surgery (WSES), clinical scores alone are sufficiently sensitive to exclude AA, decreasing the routine need for imaging.^[19] Even modern practice in diagnostics has also led to high false positive diagnosis that is, negative appendectomy rate (NAR) , at the range of 20-40%. [5,12]

Modified Alvarado scoring system (MASS) was developed by removing one laboratory criteria from original Alvarado scoring points, with an aim in achieving accurate diagnosis of acute appendicitis in the fastest and cheapest way. [14]

Because of the lack of satisfactory sensitivity (Sn) and specificity (Sp) of both Alvarado and MASS, RIPASA score (15 clinical, 2 laboratory and one additional parameters altogether) was developed and subsequently applied specially in middle East and Asian population. [3,5,7,10,12]

Several studies showed that both MASS and RIPASA Scores are useful for diagnosis of acute appendicitis. [3,6,12] However several literatures for comparison of these two scoring systems are available. [8,9,18,20-23] Interestingly, only few comparative studies are available in children, but there are very scanty research information regarding gender-specific comparison of these two traditional scoring systems till date. [4,24-26] Available literature is silent in determining most appropriate scoring for a particular age group targeting accurate diagnosis of acute appendicitis. Our study aimed at comparing MASS and RIPASA Score in terms of sensitivity (Sn), specificity (Sp), positive and negative predictive value (PPV and NPV) and also diagnostic accuracy (DA) in both sex and in different age groups to see whether any scoring system can be recommended in a particular age group or sex.

Methods

A prospective observational study of consecutively recruited 168 patients of all age group, with right lower abdominal pain, for not more than 72 hours duration, was conducted at our tertiary care institute from February 2020 to July 2021. Research proposal was duly approved by institutional ethical committee (MMC/IEC-2020/309 dt. 11/2/2020). Proper counselling and informed consent was taken during inclusion in study group.

Exclusion Criteria

1. Patients with associated documented urological, gynaecological or surgical problems other than appendicitis and with right iliac fossa pain for more than 72 hours.
2. Pregnant females.
3. Patients with score of four or less by either scoring system.

After application of exclusion criteria, 160 patients were finally became eligible for our study. Age-wise patients were divided into three study groups: Group I- below 15 years, Group II- 15 to 60 years, Group III- 60 years and above. Every patient was assessed by history, clinical examination and some routine laboratory blood and urine tests. Two scoring methods (MASS and RIPASA) were applied to a single patient. The decision of surgical intervention was taken by surgical specialist at emergency. A cut-off threshold score of 7 in case of MASS and 7.5 in case of RIPASA Score was set as available from literature.[3,4,6,8,10,16,20] Patients with scores equal or above the cut-off were designated as "score positive or high probable" cases. Patients with score more than 4 (in MASS) or 4.5 (in RIPASA), but below cut-off were labelled as "score-negative or low probable" cases; kept for observation and scoring was repeated after 12 hours; decision of operative intervention in score negative cases was taken by same surgical specialist aided with available imaging modality.

After preoperative processing, patients were posted for surgery and sample of appendix was sent for histopathological confirmation. On basis of histopathological findings of acute appendicular inflammation, we divided patient outcomes into two categories, namely acute appendicitis (AA) and negative appendectomy (NA) cases. We compared MASS and RIPASA score among all operated score positive and negative cases and analyzed which one was better in terms of sensitivity (Sn), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV) along with diagnostic accuracy (DA) with 95% confidence interval (CI) using operative diagnosis confirmed

by histopathology as gold standard. NAR among high probable cases was also calculated. Categorical variables have been expressed as numbers and percentages. Pearson’s Chi-square test was applied among score-positive and negative cases to determine whether there is a difference between MASS and RIPASA scoring in above-mentioned statistical terms. A p value less than 0.05 was considered statistically significant. The study was successfully approved by institutional ethical board under our University.

Results

For MASS, the overall Sn, Sp, PPV, NPV and DA were 70.40, 56.45, 71.87, 54.68 and 65 percent respectively (chi-square statistic 11.4154, p= 0.000728). The same values of RIPASA score were 88.34, 70.17, 84.25, 76.92 and 81.87 percent respectively with the chi-square statistic 57.2911, p <0.00001. Overall NAR in score-positive cases was seen 28.12% with MASS (n=96) in contrast to 15.74% with RIPASA scoring system (n=108).

Among 160 selected patients, 93(58.13%) were males and 67 (41.87%) were females. Overall Sn, Sp and DA of RIPASA score is found to be higher irrespective of sex. (Table A)

Table A: Comparative study analysis of RIPASA and MASS

	RIPASA	MASS
Sensitivity (Male)	90.14%	69.09%
Sensitivity (Female)	84.31%	63.15%
Specificity (Male)	50%	63.15%
Specificity (Female)	68.75%	44.82%
PPV(Male)	85.33%	73.07%
PPV(Female)	89.58%	60%
NPV(Male)	61.11%	58.53%
NPV(Female)	57.89%	48.14%
DA(Male)	80.64%	66.66%
DA(Female)	80.59%	55.22%
The chi-square statistic and p-value (Male)	The chi-square statistic is 17.3382. The p-value is 0.000031. Significant at p<0.05.	The chi-square statistic is 9.4813. The p-value is 0.002076. Significant at p<0.05.
The chi-square statistic and p-value (Female)	The chi-square statistic is 16.8797. The p-value is 0.00004. Significant at p<0.05.	The chi-square statistic is 0.4359. The p-value is 0.509085. Not Significant at p< 0.05.

Calculated NAR with score positive MASS (score 7 and above) in male (n=52) and female (n=40) patients were found to be 26.92% and 40% respectively. The same values for male (n=75) and female (n=48) with score positive RIPASA (score 7.5 and above) were 14.66% and 10.41% respectively.

Different age groups were created among selected

total 160 patients, namely Group I (n=72), Group II (n=63) and Group III (n=25). RIPASA score dominated significantly over MASS in terms of the DA, Sn, Sp, PPV and NPV in all three groups(Figure A, Figure B and Figure C), particularly in group I(p <0.00001): Comparative analysis in bar diagram in Group I

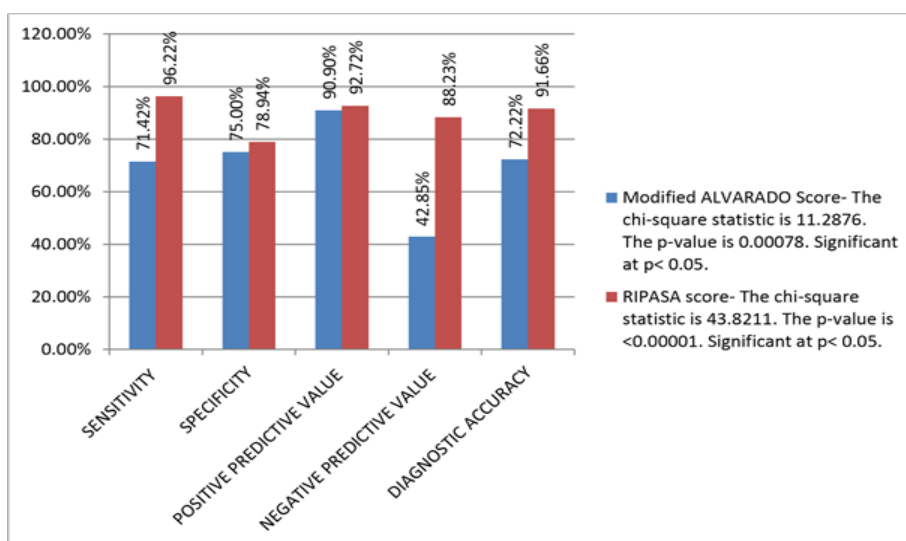


Figure 1: Comparative analysis in bar diagram in Group I

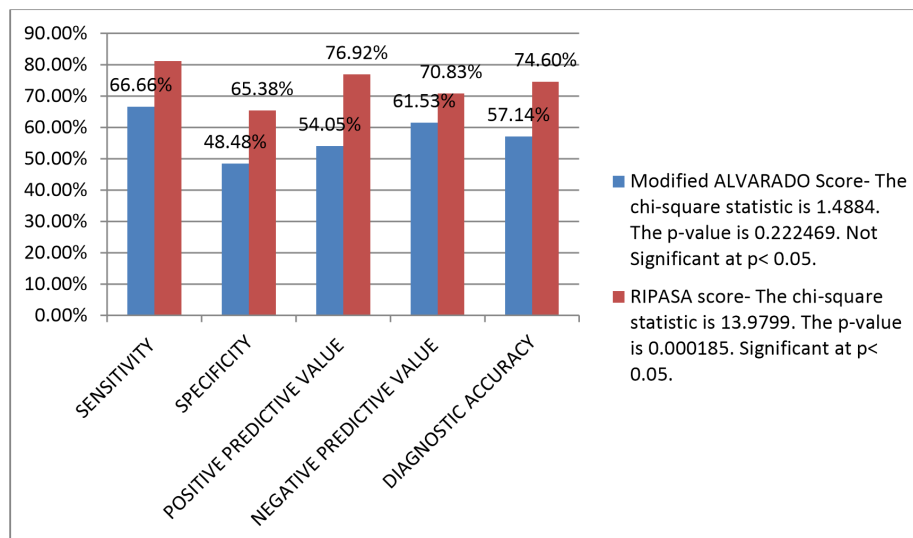


Figure 2: Graphical analysis in group II

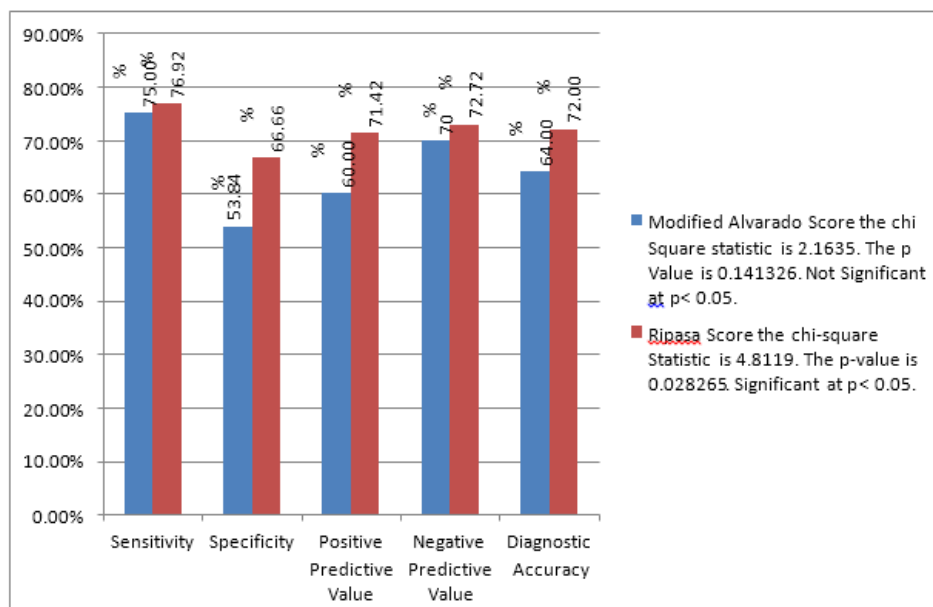


Figure 3: Comparative study in group III

NAR in score-negative RIPASA cases (n=52) is 76.92% which was, in contrast, 54.68% seen with score-negative MASS (n=64). The NAR in score-positive RIPASA in Group I (n=55), Group II (n=39) and Group III (n=14) are 7.27%, 23.07% and 28.57% respectively. The same NAR in score-positive MASS in Group I (n=44), Group II (n=37) and Group III (n=15) are 9.09%, 45.94% and 40% respectively. For score-negative RIPASA cases, NAR in Group I (n=17), Group II (n=24) and Group III (n=11) are 88.23%, 70.83% and 72.72% respectively. The same NAR in score-negative MASS in Group I (n=28), Group II (n=26) and Group III (n=10) are 42.85%, 61.53% and 70% respectively.

Discussions

Acute appendicitis is the most common surgical emergency. It is a surgical pathological condition at

all age groups. The diagnosis of appendicitis is mostly based on clinical history and physical examination aided by laboratory tests. However, making a quick and accurate diagnosis of acute appendicitis can be difficult. [4] Radiological study like ultrasonography and computed tomography (CT) scan and diagnostic laparoscopy have a promising role in diagnosing acute appendicitis but they are not routinely recommended at emergency settings. [18]

To aid in correct diagnosis several scoring systems are in practice since long. A scoring system would work ideally as an effective tool complementing clinical acumen to increase the diagnostic accuracy of decision-making, while reducing the need to expose patients to harmful imaging or increase time before surgical intervention to prevent appendicular perforation. Alvarado or MASS and RIPASA score

are most popular scoring system in clinical practice. [7,8,11]

In our study, MASS showed overall satisfactory Sn but low Sp and DA. Although MASS was found significantly sensitive with a satisfactory accuracy in male patients; both the measures drop in females of all age groups in our study population. However, MASS was found significantly sensitive, specific and accurate in young patients aged below 15 years (Group I). (Figure A) Öztas T et al, had similar findings in patients with mean age of 11.3 years. [4] NAR in above-mentioned study, using MASS, was 16.88% (versus 9.09% in our study) in score-positive cases but this value shoots to 58.1% (versus 42.85% in our study) in score negative cases. Another previous systematic review has documented overall high NAR (33.3%) using the Alvarado scoring system in paediatric populations. [27]

In a retrospective study Chong CF et al, showed that both MASS and original Alvarado scoring systems had poor sensitivity and specificity in Middle Eastern and Asian populations. Their study was aimed at proposing a new and better scoring system suitable for the local population. Fifteen parameters were studied among 312 patients who had undergone emergency appendectomies. The

optimal cut-off threshold score from the receiver operating curve (ROC) was 7.5, with a Sn, Sp, PPV and NPV values of 88%, 67%, 93%, and 53% respectively. The negative appendectomy rate decreased significantly from existing 16.3% to 6.9%. They concluded with these findings that new appendicitis scoring system, named RIPASA score, was promising. [5] Chong et al, further evaluated RIPASA scoring in a prospective manner among

144 patients with right iliac fossa pain and found its Sn of 97.5% with a DA as high as 91.8%. [6] These findings were further verified by several researchers, like, by Rathod S et al, in a prospective study, and by Bhatnagar SP et al, in a cross-sectional study. [7,12] However, the above mentioned studies didn't compare RIPASA score with any other score.

In our present study, RIPASA score, in terms of those statistical measurements, showed more or less similar figures. RIPASA score was found to be significantly sensitive, specific and accurate with acceptable NAR, particularly in score-positive cases.

Table B summarizes different study results comparing Alvarado / MASS and RIPASA scoring and our study correlations.

Table B: ALVARADO / MASS (cut-off =7.0) Versus RIPASA Score (cut-off =7.5)

Author	Study type	Sample Size	Sn%	Sp%	PPV%	NPV%	DA%
Öztas T et al [4]	Cross - Sectional	163	68.2 (77.9)*	72.2 (61.1)*	95.1 (94.1) *	22.0 (25.5) *	68.7 (76.0) *
Chong CF et Al [6]	Prospective	192	68.3 (98.0)	87.9 (81.3)	86.3 (85.3)	71.4 (97.4)	86.59 (91.8)
Shivakumar T et al [8]	Observational	70	30.9 (94.1)	6.0 (33.3)	100.0 (97.0)	94.0 (80.0)	30.9 (94.3)
Nanjundaiah N et al [11]	Prospective	206	58.9 (96.2)	85.7 (90.5)	97.3 (98.9)	19.1 (73.1)	-
Noor S et al [20]	Prospective Cross-Sectional	300	90.0 (98.5)	80.0 (68.1)	96.8 (98.9)	21.8 (97.9)	69.3 (97.7)
Dezfuli SAT et al [21]	Analytical Cross-Sectional	212	53.9 (93.4)	70.2 (45.6)	70.7 (69.6)	53.3 (83.9)	-
Meer M Chisti et al [22]	Prospective	107	64.4 (94.4)	58.8 (76.5)	89.2 (95.5)	23.8 (72.2)	63.5 (85.9)
Damburaci N et al [23]	Prospective	100	88.0 (94.0)	69.0 (88.0)	-	-	-
Present study	Prospective Randomized	160	70.4 (88.3)	56.4 (70.1)	71.8 (84.2)	54.6 (76.9)	65 (81.8)
*Corresponding RIPASA score measure values are in bracket							

The Sn, Sp and DA of MASS ranges from 31 to 90, 6 to 88 and 31 to 86.5 percent respectively while the same outcomes in RIPASA scoring ranges from 78 to 98.5, 33 to 90.5 and 76 to 98 percent showing clear superiority of RIPASA scoring than Alvarado / MASS in all available statistical terms. Our study results matched with above study results. RIPASA score in our study population was found

significantly better than MASS in terms of DA, Sn, Sp, PPV and NPV than MASS in our study.

The NAR among score-positive RIPASA patients was low and acceptable (15.74%) in contrast to score-positive MASS cases (28.12%). RIPASA cases showed high NAR in score-negative cases in contrast to MASS score-negative cases, suggesting its accuracy.

However, Diaz-Barrientos CZ et al, in an observational, analytical study of 72 patients didn't find any advantage of RIPASA Score over the MASS when applied to patients presenting with suspected acute appendicitis.^[9]

RIPASA score was found to be an effective tool with significantly high Sn, Sp and DA values both in males and females of all age groups in contrast with MASS. Although MASS showed satisfactory Sn and DA in males of all age groups, it showed lower Sn and accuracy in female patients of all age groups. (Table A) However, Capoglu et al, in their retrospective comparative analysis, did not find significant difference of Sn and Sp in males and females using the multiple scoring systems, including the above two. [24]

RIPASA scoring was particularly sensitive, specific and fairly accurate in children and young adults below 15 years (Group I, n=72). (Figure A) RIPASA had higher accuracy, Sp and slightly higher Sn in comparison with MASS when applied to elderly patients (Group III, ≥ 60 years, n=25). (Figure C) But in middle age group (Group II, 15 to 60 years, n=63), MASS showed lowest accuracy, low Sn and Sp in contrast to corresponding RIPASA score outcomes.(Figure B) This analysis showed superiority of RIPASA Scoring particularly in all age groups. (Group I, II and III) Although comparative analysis of RIPASA and MASS is available in pediatrics population, no such age-group specific comparative analysis is available in literature till date.

Conclusion

In our unique comparative study of RIPASA scoring and MASS, we found that RIPASA Scoring method is an easy, affordable and reliable scoring system with a better diagnostic accuracy compared to MASS. RIPASA scoring has highest diagnostic accuracy in children and young adults below 15 years of age. Significantly higher accuracy rate of RIPASA score was also observed in middle aged patients and elderly patients in comparison with MASS.

Thus, RIPASA scoring can be a useful tool in casualty department for patients with suspected acute appendicitis for quick decision and transfer of patients for immediate surgery and thus to prevent risk of complications. This scoring, although started for local population of Brunei, can be utilised in areas which lack imaging modalities, like in rural and primary health centres, particularly in this part of the world.

Study Limitation: Our study is single centred study and the sample size is not so large. So a multicenter study with larger sample size is required for further validation of our study.

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