

A Prospective Study of Comparative Evaluation of High Resolution Ultrasonography and Ohmanns Scoring System in Diagnosis of Acute Appendicitis

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Abstract: ***Background:** Acute appendicitis is the most common clinical diagnosis in general surgery clinics for which patients require urgent surgery. Delayed diagnosis, may cause complications like perforation of the appendix or abscess formation, and misdiagnosis, may lead to unnecessary surgery. To minimize these cases several scoring systems have been developed based on various symptoms, signs, and some basic laboratory investigations. **Aims and objective:** To compare sensitivity, specificity, positive predictive value, and negative predictive value of OHMANN'S SCORING SYSTEM VERSUS HIGH-RESOLUTION ULTRASONOGRAPHY. **Materials and methods:** A Prospective study was carried out in 50 patients presented with right lower quadrant pain who underwent appendectomy. Ohmanns Score of each patient calculated using clinical parameters and laboratory findings and HR-USG findings of each patient were noted down preoperatively. After appendectomy, the specimen was sent for HPE (histopathological examination). Sensitivity, Specificity, Positive predictive, and negative predictive values are then calculated using HPE findings as gold standard. **Results:** Sensitivity and negative predictive value of HR-USG is higher than Ohmanns Scoring System, whereas Specificity and Positive predictive value of Ohmanns scoring system is higher than that of HR-USG. **Conclusion:** Sensitivity and negative predictive value of HR-USG is higher than Ohmanns Scoring System, whereas Specificity and Positive predictive value of Ohmanns scoring system is higher than that of HR-USG.*

Keywords: HR-USG: High Resolution Ultrasonography, RIF: Right Iliac fossa, RLQ: Right lower quadrant, AA: Acute Appendicitis, CSS: Clinical scoring system

1. Introduction

Acute appendicitis is the most common clinical diagnosis in general surgery clinics. It is very important to make accurate and early diagnosis to reduce both the rate of negative laparotomy and the morbidity and mortality associated with acute appendicitis. There are several clinical scoring system as well as radiological investigations used to diagnose the acute appendicitis. HR-USG is most common standard tool used in diagnosis of acute appendicitis. Findings^[1] like Anteroposterior diameter >6 mm; Ecogenic changes in the periapendicular fat; Non-compressible tubular image; Free liquid in the abdominal cavity; Target sign; Thickness of the apendicular wall >2 mm; strongly suggests acute appendicitis in most cases. In our study, we compare sensitivity, specificity, positive predictive value, and negative predictive value of the Ohmann scoring system with high-resolution ultrasonography (HR-USG). The Ohmann scoring system was developed by Christian Ohmann et al^[2] in 1999. They conducted a comparative trial comparing two groups of patients in eight departments of surgery in Germany and Austria in the year 1994-95 after framing Ohmann's score. It is a continuous type of Clinical scoring system which gives graded risk stratification and consists of eight variables described below:

OHMANN Scoring System

Clinical Findings	Points
TENDERNESS IN RLQ	4.5
REBOUND TENDERNESS on C/L SIDE	2.5
DYSURIA	2.0
STEADY PAIN	2.0
LEUCOCYTOSIS (>10,000/mm ³)	1.5
AGE > 50yrs	1.5
MIGRATION OF PAIN TO RLQ	1.0
ABDOMINAL RIGIDITY	1.0

Patients whose score is less than 6.5 are evaluated as "low probability of appendicitis," while a score of between 6.5 and 12 is interpreted as "may have appendicitis" and follow-up is recommended. A score of 12 or more is seen as "most likely has appendicitis."

Aims and Objectives: In our study we compare sensitivity, specificity, positive predictive value and negative predictive value of Ohmann scoring system with High resolution ultrasonography in diagnosis of acute appendicitis

2. Materials and Methods

All patients presented with right lower quadrant pain who underwent appendectomy were part of the study. In our study, we included a total of 50 patients as per the study by Zielke A et al^[3]. The Patient with suspected appendicitis was admitted to the department of surgery and a complete physical examination and routine blood investigations were done. Each patient also underwent HR-USG using 7-11MHz linear probe with the sonologist being unaware of clinical examination findings. The Ohmanns Score of each patient

calculated using clinical parameters and laboratory findings and HR-USG findings were noted down preoperatively.

Receiver operating characteristic (ROC) curve (Figure 1) were obtained to represent the ratio of true vs. false positives and to determine a discrimination threshold and the higher sensitivity value to predict acute appendicitis.

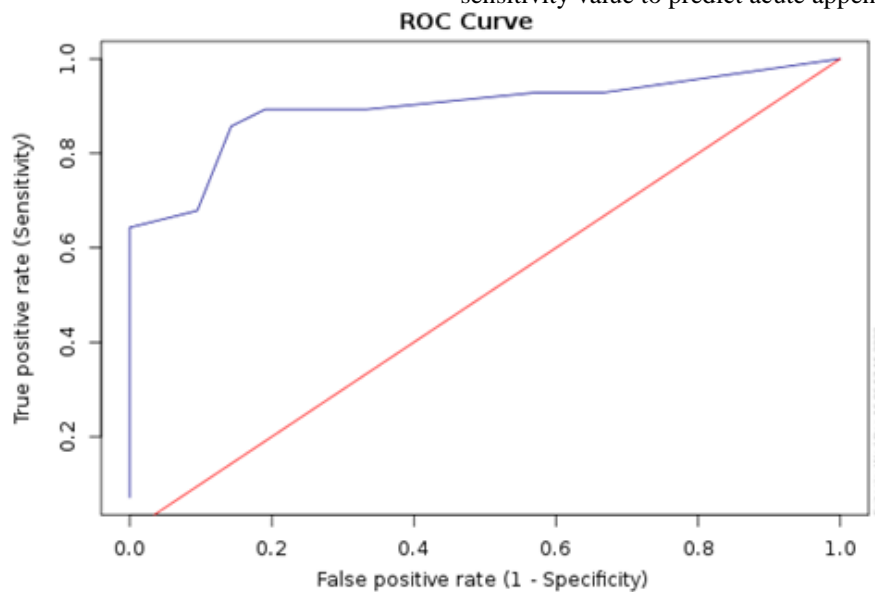


Figure 1: Receptor Operator Curve to represent the ratio of true positive & false positive

For finding the optimum cut-off points for Ohmanns score to predict acute appendicitis we drew ROC curves(Fig.12.1) taking HPE findings as the gold standard. The cutoff was taken as the Ohmann score value corresponding to

maximum Youden's maximum J value (sensitivity + specificity-1) (Fig.12.2).

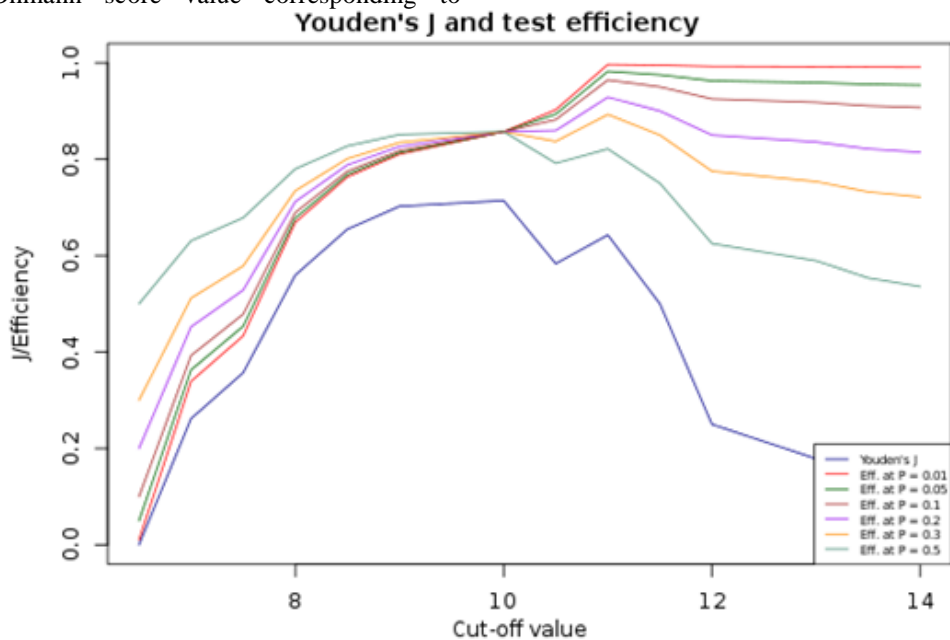


Figure 2: Graph of Youden's J and test Efficiency

Table 1: Cut-points to maximize Youden's J and test Efficiency

	Cut-Point	Sensitivity	Specificity
Youden's J	10	0.857	0.857
Eff. at P= 0.01	11	0.643	1
Eff. at P= 0.05	11	0.643	1
Eff. at P= 0.1	11	0.643	1
Eff. at P= 0.2	11	0.643	1
Eff. at P= 0.3	11	0.643	1
Eff. at P= 0.5	10	0.857	0.857

In this study patients whose Ohmanns score was less than 10 were tagged as LP (Low probability of appendicitis) while those with Ohmanns score of 10 or greater than 10 tagged as HP (high probability appendicitis).

The HR-USG findings showing acute appendicitis were tagged as 1 while those which were showing other than acute appendicitis were tagged as 0. The final decision for appendicectomy was based on the surgeon's clinical judgment after taking into consideration all the findings of clinical, laboratory & radiological investigations. After

appendicectomy, the specimen was sent for HPE (histopathological examination) (Figure 3). The patient was discharged according to his/her postop conditions accordingly and kept on follow up till the HPE report arrives. HPE reports of cases collected and compared with OHMANN'S SCORE & HR-USG findings. Sensitivity, Specificity, Positive predictive, and negative predictive values are then calculated using HPE findings as to the gold standard, and comparisons were done. McNemar's chi-square^[5] test was applied to test the statistical significance.



Figure 3: Specimen sent to Department of Pathology for HPE evaluation

Inclusion criteria: All age group with pain in right iliac fossa ; underwent appendicectomy as primary procedure, give consent for the study.

Exclusion criteria: Non- RIF pain, appendicectomy was performed as part of procedure, appendicular lump, elective appendicectomy, inability to understand and give consent.

3. Results

In the present study, a total of 50 patients of all age groups were included. The maximum number of patients belonged to the 2nd to 4th decade. Both sexes were affected with slight male preponderance (58% males and 42% females).

Ohmann's score was evaluated for all 50 patients in the study. Of which tenderness in RIF region present in 50 patients (100% cases), steady pain in 48 patients (96% cases), abdominal rigidity in 24 patients (48% cases), migration of pain to RIF in 19 patients (38% cases), rebound tenderness in 15 patients (30%), dysuria in 10 patients (20% cases), leukocytosis in 14 patients (28% cases), and 5 patients (10% cases) were above 50 years of age. (Figure 4)

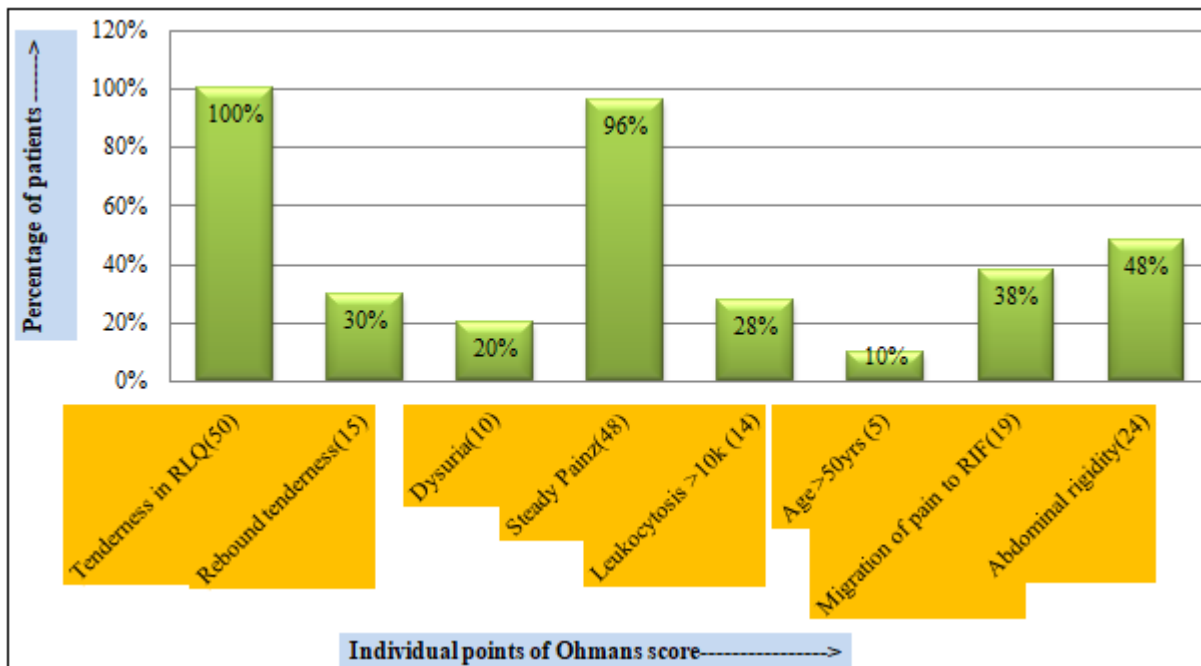


Figure 4: Showing the prevalence of individual points of Ohmann's score in the study

Score wise analysis shows Ohmann's score of 6.5 present in 18% of patients, a score of 10 and 11.5 present in 14% of patients each, a score of 7.5 present in 12% of patients, a score of 11 present in 8% of patients, score of 10.5 present

in 6% of patients, scores of 7,8,9,13 and 14 present in 4% of patients each, scores of 8.5,12,12.5 and 13.5 present in 2% of patients each, score less than 6.5 and greater than 14 was present in 0% of cases each (Figure 5)

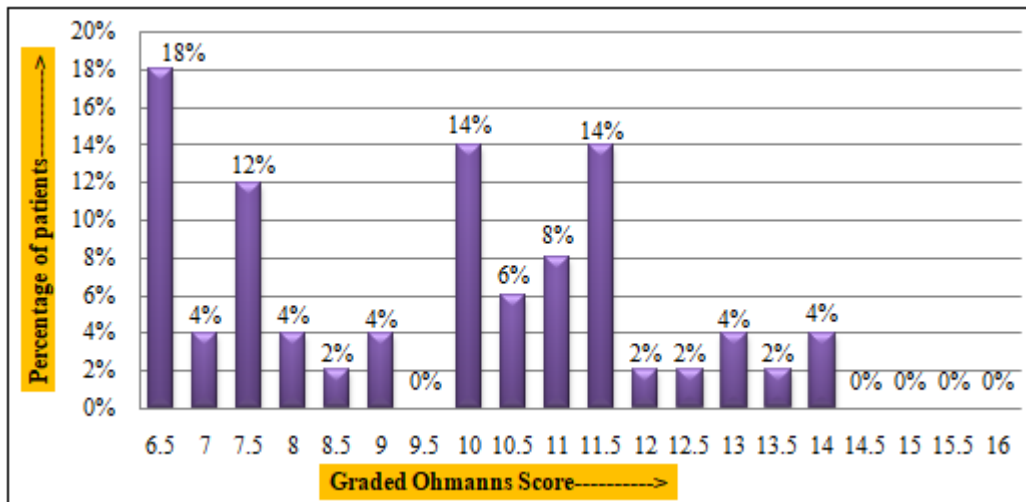


Figure 5: Showing prevalence of Graded Ohmanns score in the study

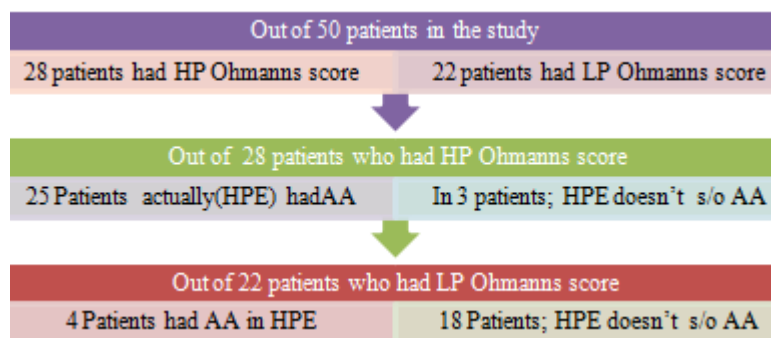


Table 2: Statistical Analysis of Ohmanns Scoring System

Parameter	Estimate	Lower - Upper 95% CIs
Ohmann's score		
Sensitivity	86.21%	68.21% -96.11%
Specificity	85.71%	63.66% - 96.95%
Positive Predictive Value	89.29%	74.32% -96.00%
Negative Predictive Value	81.82%	64.05% - 91.91%

Interpretation: In this study, Sensitivity was 86.21% with 95% confidence interval (68.21% -96.11%), and specificity was 85.71% with 95% confidence interval (63.66% - 96.95%). Positive Predictive Value (PPV) showed an estimate 89.29% with 95% confidence interval (74.32% - 96.00%). Negative Predictive Value (NPV) 81.82% with 95% confidence interval (64.05% - 91.91%).

Analysis of HR-USG Findngs

Among 50 patients HR-USG showed Acute appendicitis in 35 patients (70% of cases) and it was inconclusive in 15 patients (30% of cases). In our study HR-USGs showing acute appendicitis were said to be HP (high probability of having acute appendicitis) and tagged as 1; while those

which were inconclusive were LP (low probability of having acute appendicitis) and tagged 0.

All 50 patients were operated upon with a diagnosis of appendicitis among which 29 patients (58% of cases) turned out to acute appendicitis and 21 patients (42% of cases) recurrent appendicitis in a biopsy report. All patients were followed up on OPD basis regularly up to 6 months period and no complication was seen.

To further compare Ohmanns score and HR-USG, the category-wise analysis was done. We compared Ohmanns score and HR-USG with the biopsy report. We found that among all patients 56% had HP on Ohmanns score of which 89.2% had acute appendicitis, 10.7% had recurrent appendicitis. 44% had LP on Ohmanns score of which 18.1% had acute appendicitis and 81.8% had recurrent appendicitis.

Among all patients 70% had HP and 30% had LP on HR-USG. Among HP 77.1% of patients had acute appendicitis, 22.8% had recurrent appendicitis. 30% had LP out of which 13.3% patients had acute appendicitis, 86.67% had recurrent appendicitis.

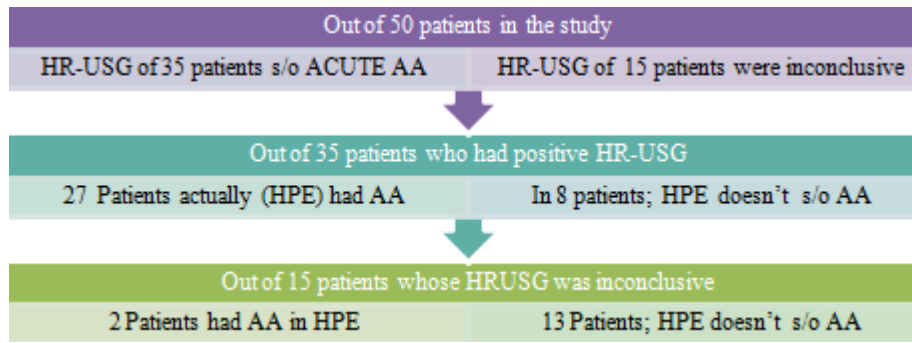


Table 3: Statistical analysis of HR-USG Findings

Parameter	Estimate	Lower - Upper 95% CIs
HR-USG Finding		
Sensitivity	93.10%	77.23% -99.15%
Specificity	61.90%	38.44% -81.89%
Positive Predictive Value	77.14%	65.98% - 85.45%
Negative Predictive Value	86.67%	62.08% - 96.27%

Interpretation: In this study, Sensitivity was 93.10% with 95% confidence interval (77.23% -99.15%) and specificity was 61.90% with 95% confidence interval (38.44% - 81.89%). Positive Predictive Value (PPV) showed an estimate 77.14% with 95% confidence interval (65.98% -

85.45%) Negative Predictive Value (NPV) showed an estimate 86.67% with 95% confidence interval (62.08% - 96.27%).

Table 4: Comparison between Ohmanns Score and HR-USG

Parameters	Ohmanns Score	HR-USG
Sensitivity	86.21%	93.10%
Specificity	85.71%	61.90%
Positive Predictive Value	89.29%	77.14%
Negative Predictive Value	81.82%	86.67%

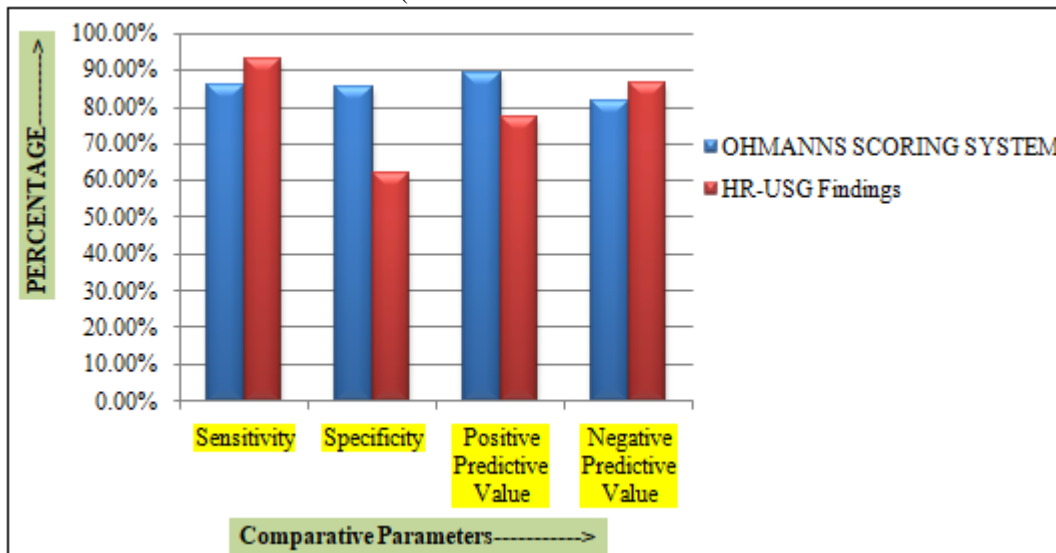


Figure 5: Comparison of Ohmanns Score versus HR-USG

Significance

The sensitivity and negative predictive value of HR-USG is higher than Ohmanns Scoring System, whereas the Specificity and Positive predictive value of Ohmann's scoring system are higher than that of HR-USG

4. Conclusion

From the present study, it was concluded that sensitivity and negative predictive value of HR-USG is higher than Ohmanns Scoring System, whereas Specificity and Positive predictive value of Ohmann's scoring system are higher than that of HR-USG. However, on statistical analysis, the difference between sensitivity was found to be not significant. (p-value> 0.05). None of the HR-USG or Ohmanns score is completely reliable in diagnosing or ruling out acute appendicitis. The combined use of both the Ohmanns score and HR-USG can increase the diagnostic

accuracy and can reduce the negative appendectomy rate as well as the morbidity and postoperative complications.

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