Evaluation of Modified Alvarado Score and Ultrasonography for the Diagnosis of Acute Appendicitis

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1. Introduction

Acute appendicitis is one of the commonest surgical emergencies. Although the morbidity and mortality from appendicitis has decreased in the last 50 yrs, the diagnostic specificity remains low with false positive rate of 20-25% [1]. Most physicians are familiar with textbook appearance of appendicitis; anorexia, nausea and vomiting associated with periumbilical pain which shifts to the right lower quadrant with tenderness at McBurney’s point and leucocytosis. Several investigations like white cell count, ultrasonography, CT scan, can be done to diagnose acute appendicitis with variable accuracy [2].

Mohanty and Kaushik studied the modified form of Alvarado score [8]. The last criteria of shift to left of neutrophils was omitted because of lack of facilities, instead patients were subjected to USG of abdomen. The combined technique of using both clinical and sonographic criteria significantly improved the diagnostic accuracy especially in females (93.3%). As studied by Stephens and Mazzucco, ultrasound alone resulted in correct diagnosis in 87% cases and Alvarado score alone can diagnose 88% cases [9].

The present study was conducted at Rajindra Hospital, Patiala to evaluate the usefulness of modified Alvarado score and ultrasonography to compare the sensitivity and specificity of both and evaluate the value of using both modalities together.

2. Material and methods

Fifty patients admitted with clinical diagnosis of acute appendicitis irrespective of age and sex formed the material of this study. Cases of appendiceal mass and peritonitis were not included. On admission detailed history was recorded and thorough physical examination was done. Alvarado score was calculated.

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observation in hospital. However surgery was performed if Alvarado score increased to up to 7 or above. All patients were subjected to USG. Ultrasonographic criteria were:

- Non compressible appendix with diameter > 6 mm or wall thickness > 3mm
- Complex mass (echo poor, asymmetric)
- Loss of contour
- Free fluid
- Local adynamic ileus
- Graded tenderness over McBurney’s point

USG was done with high frequency transducer of 7.5 MHz with graded compression. Examination was done with machine Philips SDR 1550x P and permanent record was taken with automatic multifomat camera or Sony thermal videographic printer.

Other biochemical tests like Hb, BT, CT, TLC, DLC, Urine C/E, FBS, Blood urea, Serum creatinine, ECG etc. were done, if required. Surgical exploration if needed was done. Surgical findings were recorded and compared with Alvarado score findings and USG findings. All appendices removed were sent for histopathology. If pathologist reports no evidence of acute inflammation in the organ, the case was designated as false positive appendicectomy. Sensitivity and specificity of modified Alvarado score and USG was calculated separately and after combining both modalities together and was compared with available literature.

3. Observations and Discussion

The patients were categorized into three groups- Men - 1, Women – 2, Children – 3. Out of 50 patients 60% were male, 28% were female and 12% were children. Male: female ratio is 2:1 which is comparable with study of Samsi et al [10]. Age range was 5- 50 yrs. Mean age was 25 yrs.

Table 1: Showing symptoms, signs and laboratory findings

| Symptom/Sign                          | Group 1 | Group 2 | Group 3 | Overall  |
|--------------------------------------|---------|---------|---------|----------|
| Name                                  | 30 (100%) | 14 (100%) | 6 (100%) | 100%     |
| Migratory RIF pain                    | 25 (83%) | 12 (85%) | 6 (100%) | 82%      |
| Anorexia                              | 24 (80%) | 12 (85%) | 5 (83%)  | 82%      |
| Nausea/ Vomiting                      | 30 (100%) | 14 (100%) | 6 (100%) | 100%     |
| Tenderness in RIF                     | 22 (73%) | 8 (57%)  | 4 (66%)  | 68%      |
| Rebound tenderness                    | 10 (33%) | 6 (42%)  | 4 (66%)  | 40%      |
| Elevated temperature                  | 9 (29%)  | 11 (78%) | 6 (100%) | 92%      |
| Leucocytosis with total count > 10,000/cmm | 29 (96%) | 11 (78%) | 6 (100%) | 92%      |

Role of Alvarado score was studied by Saidi and Ghasemi [11]. It was found to have sensitivity of 96% in males, 58% in females and 83% in children. Crnogorac S and Lovrenski J found that Alvarado score has sensitivity of 87% and high diagnostic value of 82% [12]. Following table shows results in our study.

Table 2: Showing results of appendicectomy according to Alvarado score

| Alvarado score | Group 1 | Group 2 | Group 3 | Overall |
|----------------|---------|---------|---------|---------|
| Sensitivity    | 96.29%  | 81.8%   | 100%    |         |
| Specificity    | 66.6%   | 66%     | 100%    |         |
| Positive predict value | 92.85% | 81.8% | 100% | |
| Overall accuracy | 90%    | 71%     | 100%    |         |

The advantages of modified Alvarado score are:
1) A precise decision is made at admission as to which patients need immediate appendicectomy (score >7) and which needs period of observation (score <7).
2) The scoring system is highly sensitive for men and children. Sensitivity in men was 96% and in children was 100%.
3) False positive appendicectomy rate is only 9% when patients with Alvarado score of 7 or >7 are taken up for appendicectomy.

Thus the modified Alvarado score works extremely well in children and men. However, in women sensitivity and specificity is low. Lamparelli et al stated that compared with men, diagnosis of appendicitis in women is twice as likely to be incorrect.[13]. Sensitivity of USG in our study is found to be 86%. This is comparable with studies of Mohanty and Kaushik as 85% in their study [8]. In our study only 1 false positive case was there. It was case of tubal pregnancy. In this we study we probably visualized an appendix- mimicking structure.

Sensitivity of ultrasound was found to be more than 77% [14]. Rettenbacher T et al also concluded that even in patients with clinical probability of acute appendicitis, diagnostic imaging should be performed [15]. Ultrasound is more useful in detecting than in ruling out appendicitis [16].

Table 3: Comparing study done by Saidi and Ghasemi (2000) with present study.

| Name of study         | Sensitivity | Specificity | PPV      | Accuracy |
|-----------------------|-------------|-------------|----------|----------|
| Group 1               |             |             |          |          |
| Saidi and Ghasemi (2000) | 96%        | 95%         | 93%      | 87%      |
| Present study         | 100%        | 100%        | 100%     | 100%     |
| Group 2               |             |             |          |          |
| Saidi and Ghasemi (2000) | 58%        | 81%         | 89%      | 82%      |
| Present study         | 100%        | 100%        | 100%     | 100%     |
| Group 3               |             |             |          |          |
| Saidi and Ghasemi (2000) | 83%        | 92%         | 83%      | 90%      |
| Present study         | 100%        | 100%        | 100%     | 100%     |

Table 4: Showing results of appendicectomy according to USG

| USG findings       | Group 1 | Group 2 | Group 3 | Overall |
|--------------------|---------|---------|---------|---------|
| True positive      | 24      | 9       | 4       | 37      |
| False positive     | 1       | 1       | 1       | 3       |
| True negative      | 3       | 3       | 6       | 12      |
| False negative     | 3       | 1       | 2       | 6       |

USG with graded compression has three advantages:
1) The distance between transducer and pathologic process is reduced.
2) The bowel structures are either displaced or compressed which eliminates gas artifacts.
3) The region of maximum tenderness as indicated by the patient with his finger is approached more precisely.

Combining Alvarado score and USG markedly increased diagnostic accuracy. When both were positive 37 true positive cases were there and there was no false positive case. In women it was found to be 92% which was comparable with the study of Mohanty and Kaushik who found it to be 93.3%.

Table 5: Comparing Alvarado score, USG and both modalities together.

|                | Alvarado score | USG | Combining both |
|----------------|----------------|-----|---------------|
| Sensitivity    | 95%            | 86% | 86%           |
| Specificity    | 42%            | 85% | 100%          |
| Positive predictive value | 91% | 97% | 100%          |
| Overall accuracy | 88% | 86% | 88%           |

4. Summary and Conclusions

When the modified Alvarado score was combined with USG, diagnostic accuracy is 92% in females. Specificity of combining both is 100%. When Alvarado score is equivocal, the addition of USG helped to make the diagnosis of acute appendicitis or alternative diagnosis was made.

The modified Alvarado score should be combined with USG for the diagnosis of acute appendicitis. But nothing can replace careful evaluation by an experienced surgeon.

5. Future Scope

For more reproducible outcome for the combined usage of modified Alvarado score and USG, an extended study with more no of patients is advisable.

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