Comparison Between the Tzanakis Scoring System and Yash Scoring System in the Diagnosis of Acute Appendicitis

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Abstract

Background: Acute appendicitis is amongst the most encountered emergencies seen in casualties requiring intervention. The incidence of negative laparotomy is 15% to 25% and is associated with notable morbidity. Scoring systems are useful and logical for distinguishing acute appendicitis from non-specific abdominal pain. Presently many scoring systems exist that aids in the diagnosis of acute appendicitis but still fail to decrease the rates of wrong diagnosis and the negative appendicectomy rate. This comparative study has been undertaken to evaluate and compare the efficacy of the Tzanakis scoring system with the relatively newer Yash scoring system which has been found more effective for the Indian population in diagnosing acute appendicitis.

Aim: To compare the efficacy of the Yash scoring system with the Tzanakis scoring system in diagnosing acute appendicitis.

Method and Material: A prospective comparison of the Tzanakis scoring system and Yash scoring system was done on 50 patients. The decision of an appendicectomy was taken by the consultant surgeon. The outcomes of the Tzanakis scoring system and Yash scoring system in terms of sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated and compared.

Results: The Yash scoring system had sensitivity, specificity, PPV, NPV, and DA of 94.28%, 93.33%, 97.05%, 87.50%, and 94% respectively. The Tzanakis scoring system had sensitivity, specificity, PPV, NPV, and DA of 71.42%, 66.67%, 83.33%, 50%, and 70% respectively.

Conclusion: The Yash scoring system was significantly better than the Tzanakis scoring system in diagnosing acute appendicitis.

Keywords: *Appendix, laparotomy, score, diagnosis, inflammation.*

Introduction

Acute appendicitis is amongst the many encountered emergencies seen in casualties requiring intervention. There is a 6% chance of appendicitis in the general population[1]. Though the mortality has declined from 26% to 1% with the dawn of broad-spectrum antibiotics and timely surgery, it remains 5 to 15% in the elderly [2]. The incidence of negative laparotomy is 15% to 25% and is associated with notable morbidity, the frequency being more in women of reproductive age group (till 45%) due to the commonness of inflammatorytubo-ovarian diseases, ectopic pregnancy, and other gynecological pathology[3]. The delay in diagnosis may lead to rupture of the appendix in 17% to 40% of cases mostly in extremes of age. In the adolescents and elderly,

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it is linked with dramatic complications like an intra-abdominal abscess, wound infection, and ultimately death [4].Thus, confirmation of acute appendicitis is very crucial to achieve lower morbidity and mortality rates.

Conventional history and clinical examination continue to exist as the potent and actual diagnostic modalities in pinpointing acute appendicitis[5]. The chronology is the commencement of periumbilical pain shifting to the right iliac fossa with subsequent development of anorexia and nausea or vomiting. The clinical examination may disclose signs resembling peritonitis such as local rebound tenderness (Blumberg's sign), guarding, rigidity, cutaneous hyperesthesia, and tenderness on rectal examination. Thirty-three percent of all cases with inflamed appendix present with unusual symptoms such as blunting of pain by the presence of overlying bowel in cases of retrocecal or retro iliac position of the appendix, increased urinary frequency, and tenesmus. Several conditions mimic appendicitis such as enterocolitis, terminal ileitis, pelvic inflammatory diseases, ureteric colic, peptic ulcer, diverticulitis, etc, and hence should be considered in the list of differential diagnosis[6].

The regular laboratory investigations of blood and urine are necessary. Leukocytosis is a convenient finding but is non-specific and may be missing in the elderly [2]. C–Reactive protein is elevated in almost all acute inflammatory conditions, hence is considered as a non-specific marker but its estimation guides a surgeon in reducing negative appendicectomies[7].

Plain x rays have validity in diagnosing appendicitis in only 8% of cases showing non-specific findings with low sensitivity and specificity [8]. The reliability of barium enema examination is 50% to 84%, but it has a major complication of caecal perforation when done in acute inflammatory conditions [9].Computed tomography (CT) is another imaging modality used to confirm appendicitis and is exceedingly efficacious and precise. It is operator independent and has shown a sensitivity of 90% to 100% and specificity of 91% to 99%.CT has a positive predictive value (PPV) of 92% to 98% and a negative predictive value (NPV) of 95% to 100%[10].

Ultrasonography (USG) with graded compressions has immense capacity in diagnosing appendicitis in its acute stage[10]. Various studies have been conducted on the utilization of these imaging systems. These studies reported sensitivity of 75% to 94%, a specificity of 86% to 100% and gross precision up to 96%[10,11]. Its superiority over computed tomography is the absence of exposure to ionizing radiation thus helpful in pregnant and paediatric patients. The major disadvantage is that it is operator dependent leading to inter-observer bias and failure to see the appendix during the scan does not rule out the possibility of having an inflamed appendix[10].

Magnetic resonance imaging (MRI) as an investigation is only taken typically in the pregnant population where radiation exposure is not warranted. It provides outstanding resolution and is highly efficient in diagnosing acute appendicitis. MRI has high sensitivity and specificity of 100% and 98% respectively. The PPV and NPV of MRI are 98% and 100% respectively. It is also operator-independent. The only issue is its higher cost, motion artifact, and complexity in reading MRI by non-radiologistswith limited experience [11].

Despite the use of all these imaging techniques, the incidence of negative appendicectomy is not decreasing. These unmerited operations have a complication rate of approximately 13%, which is nearby to that of an inflamed appendix. Removal of a healthy appendix has a mortality of 0.65%. Protracted clinical observations aiming to reduce undesired operations may mean a delay in operations in 28% of cases and considerable danger of perforation [12].

Scoring systems are useful and logical for distinguishing pain of acutely inflamed appendix from vague abdominal pain. Presently numerous scoring systems exist that aid in diagnosing acute appendicitis. However, these systems do not replace clinical acumen thereby just helping in the determination of acute appendicitis and aids in approaching a conclusion, whether a particular case should be operated or not, thus lowering the negative appendicectomy rate (NAR).

The original study done by Tzanakis et al[13] in Greece reported sensitivity and specificity of 95.4% and 97.4% respectively. The diagnostic effectiveness of the score was 96.5% in his study. But in India, this scoring system was found inferior. For example, a comparative study between Tzanakis score and Alvarado score done by Shashikala V[14] in India revealed that Tzanakis scoring system had a sensitivity of 79.62%, a specificity of 83.3%, PPV of 97.72%, and NPV of 31.25% which was found better than Alvarado scoring system but still posing difficulties in diagnosis with a NAR of 12%. Another study was done by Iqbal MM et al[15] in

Postgraduate medical center, Karachi, Pakistan revealed that the Tzanakis score had a sensitivity of 99%, a specificity of 91%, PPV of 99%, and NPV of 91% with a diagnostic accuracy of 95%. Similarly,A study done in Kathmandu Model Hospital, Nepal did by Sigdel GS et al [16] reveals that Tzanakis has a sensitivity of 91.48%, a specificity of 66.66%, and diagnostic accuracy of 90%.

The study done by Lamture YR et al[17] in India on the Yash scoring system reveals a sensitivity of 99.48%, a specificity of 92.86%, PPV of 99.48%, and NPV of 92.86%.Though the validity of the Yash scoring system is promising for the Indian population, its only disadvantage was in the mode of a single study.

Despite various scoring systems and developments in the diagnostic and imaging modalities, the diagnosis of appendicitis is in dilemma which fails to decrease the rates of wrong diagnosis and the negative appendicectomy rate. This sequentially increases the cost for diagnosis by the use of expensive radiological modalities like Computed Tomography and MRI thus causing a delay in the treatment leading to an increase in morbidity and mortality of the patients.

This comparative non-randomized prospective study has been undertaken to evaluate and compare the effectiveness of the Tzanakis score with the relatively newer Yash score which has been found more effective for the Indian population in diagnosing acute appendicitis.

Method

The present study was undertaken in the department of surgery, Jawaharlal Nehru Medical College, Wardha in collaboration with Datta Meghe Medical College Hingana, Nagpur, Datta Meghe Institute of medical science (DMIMS), Sawangi, Meghe, Wardha, Maharashtra India.

Aim: To compare the efficacy of the Yash scoring system with the Tzanakis scoring system in the diagnosis of acute appendicitis.

Objectives:

1. To study the outcome of the Yash scoring system regarding its sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy.
2. To study the outcome of the Tzanakis scoring system about its sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy.
3. To compare the outcome of Yash and Tzanakis scoring system.

Study Design: Prospective non-randomized study.

Study Population: All patients of acute appendicitis with age >15 years and <60 years.

Study Duration: July 2018-July 2020.

Sample size: 50 patients

- The sample size was calculated by the modified Fischer's formula. The prevalence rate of appendicitis was taken as 6% from the study done by Yogesh Pralhad Chaudhari, Prasanna Gambhir Jawale[18] in 2015.
- Where $N \geq \{Z^2 1\text{-}\alpha/2 \times P \times (1\text{-}P)\}/d2$
- Z1-a/2 = is standard normal variate (at 5% type 1 error (P<0.05) it is 1.96 and at 1% type 1 error (P<0.01) it is 2.58). In most of the studies, P values below 0.05 are considered significant. Therefore, value of 1.96 is employed in formula**.**
- p = prevalence of appendicitis in community anticipated on the basis ofpast studies.
- d = Absolute error or precision – decided by researcher.
- p = 6%
- d = 0.07 (7% error of margin).

The minimum sample size would be 44.12 patients, thus 50 patients included in the study.

Inclusion Criteria: All patients with right lower quadrant pain and clinically diagnosed as acute appendicitis of age >15 years and <60 years.

Exclusion Criteria:

1. Patients with appendicular mass.
2. Patients of appendicitis with a known case of connective tissue disorder.
3. Patients with a past history of renal or ureteric stones and pelvic inflammatory disease.
4. Pregnant women.

Ethical clearance was obtained from the Ethics committee of DattaMeghe Institute of Medical Sciences

(Deemed to be University) [Ref.No. DMIMS(DU)/ IEC/2018-19/7426].This prospective non-randomized study was conducted in Acharya VinobaBhave Rural Hospital, Sawangi. All the patients who fulfilled the eligibility criteria were subjected to routine hematological investigations, C-reactive protein, USG, and were scored based on Yash and Tzanakis scoring system.

Tzanakis scoring system combines 4 variables as follows:

- Presence of right lower abdominal tenderness = 4 points
- Rebound tenderness (Bloomberg sign) = 3 points
- Laboratory findings: the presence of white blood cells greater than 12,000 in the blood= 2 points
- Ultrasound findings: the presence of positive ultrasound scan findings= 6 points

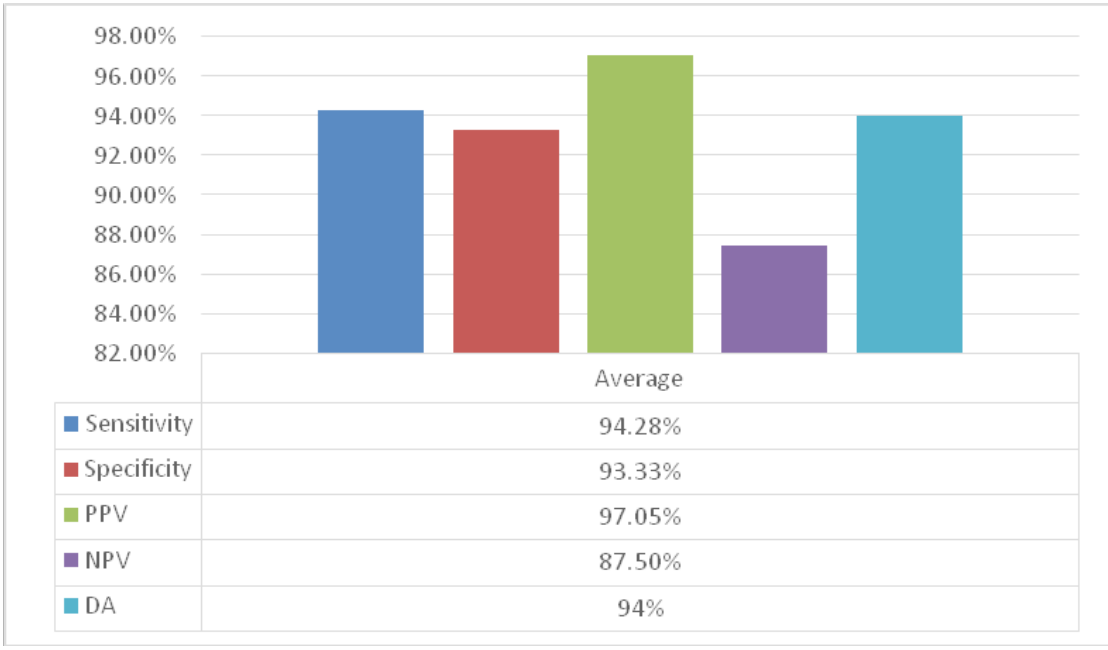
A score of 8 or more is suggestive of acute appendicitis requiring surgery[13]. Similarly, the components of the Yash scoring system are as follows:

- Migration of pain to the right iliac fossa = 1 point
- Nausea and vomiting = 1 point
- Anorexia = 1 point
- Right iliac fossa tenderness = 2 points
- Rebound tenderness = 1 point
- Hyperesthesia in Sherren's triangle = 1 point
- Fever = 1 point
- White blood cell count > 10,000 mg/dl =2 points
- C-reactive protein (> 15mg/dl) = 3 points
- Ultrasonography = 4 points

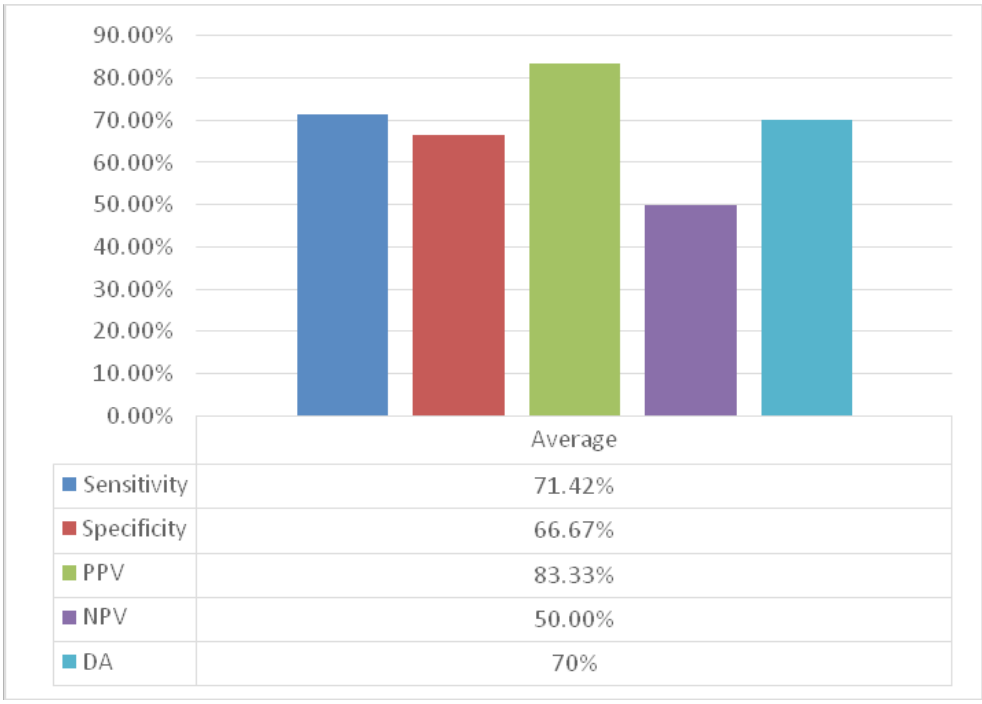
A score of 7 or more is suggestive of acute appendicitis requiring surgery[17].

The decision to operate was taken by a consultant surgeon by clinical diagnosis with help of other appropriate investigations in special circumstances. All patients underwent appendicectomy with prior consent and the specimen was subjected to histopathological examination for confirmation of diagnosis. The minimum criteria for acute appendicitis were the appearance of neutrophils in mucosa, submucosa, and lamina propria[1]. The result of the Tzanakis score and Yash score was reported independently. The result was correlated with the findings obtained on histopathological examination and the data was analyzed using the necessary statistical calculations using SPSS 24.0 version, the results were then presented.

Observations and Results

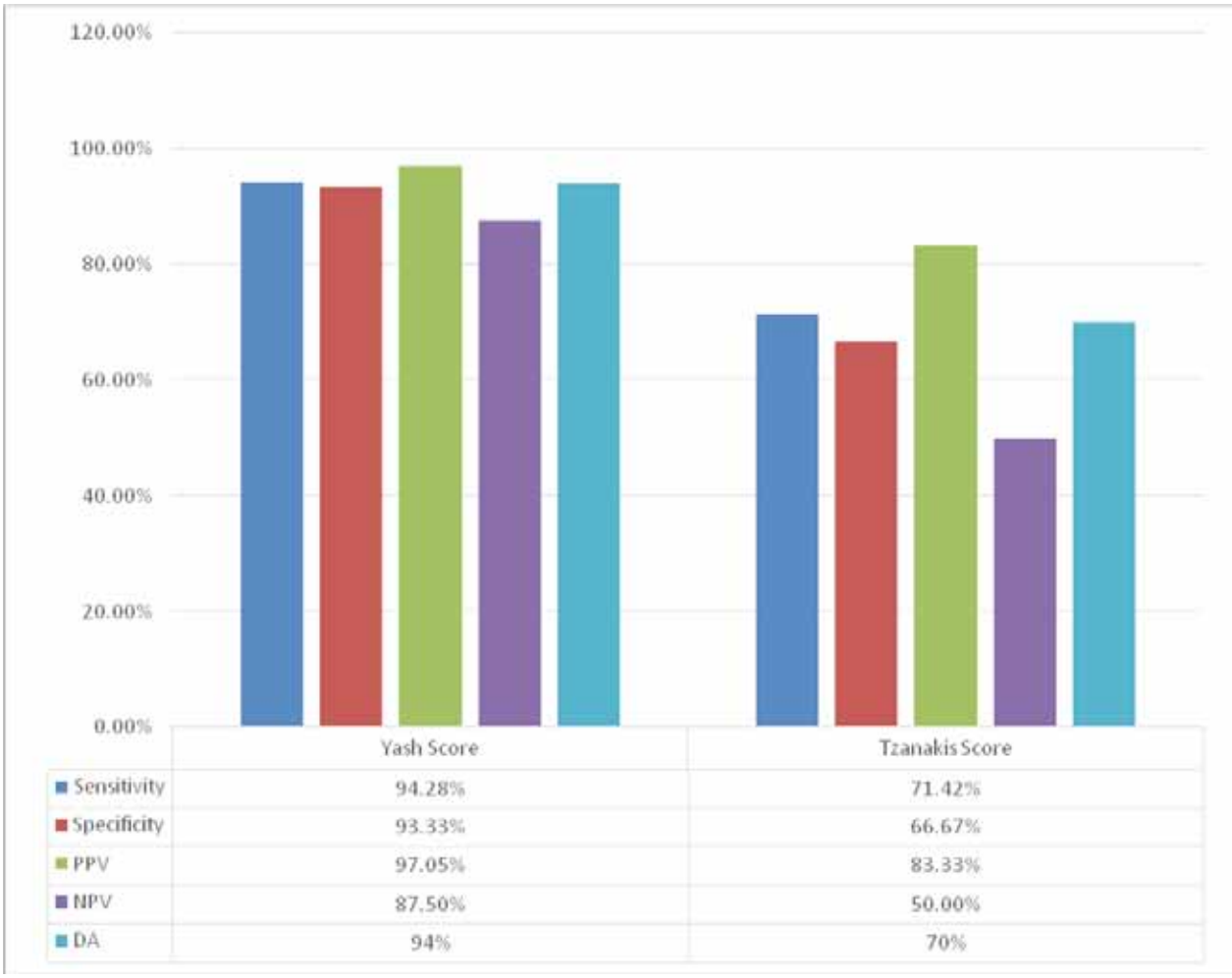


Graph 01: Outcome of YASH scoring system



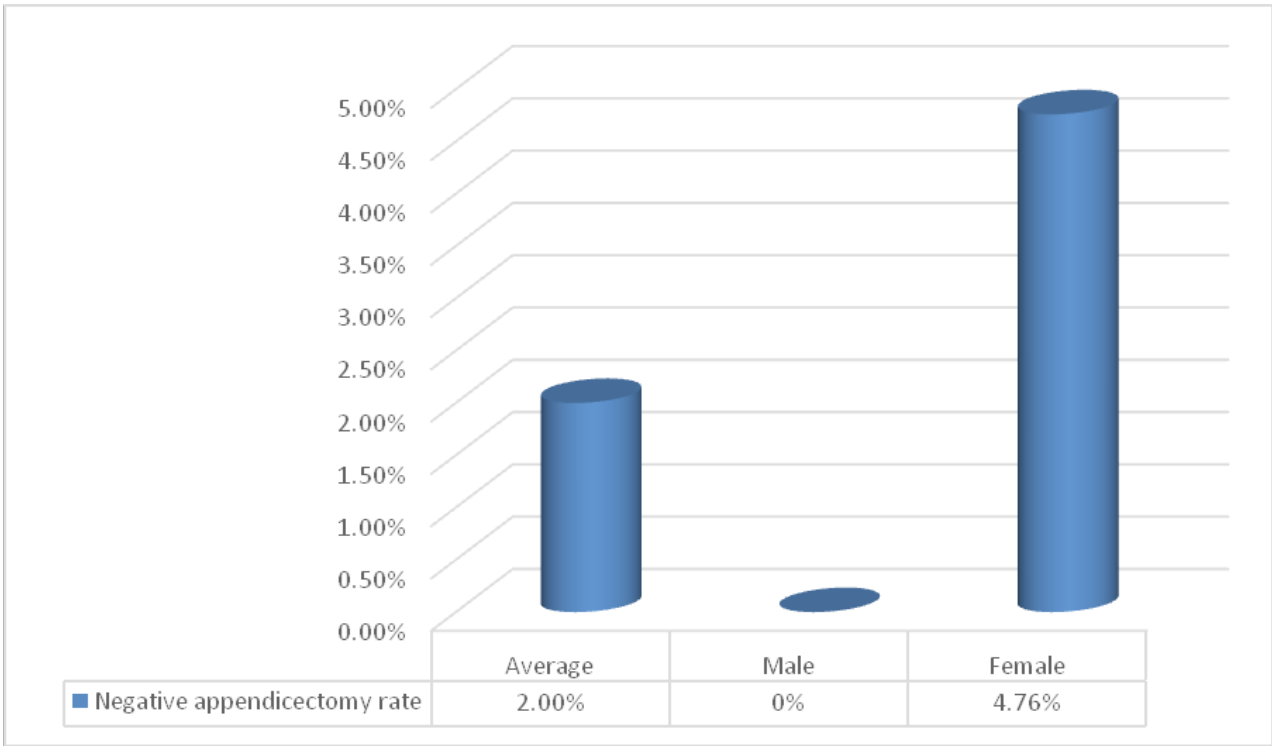
	Average
Sensitivity	71.42%
Specificity	66.67%
PPV	83.33%
NPV	50.00%
DA	70%

Graph 02: Outcome of Tzanakis Scoring system

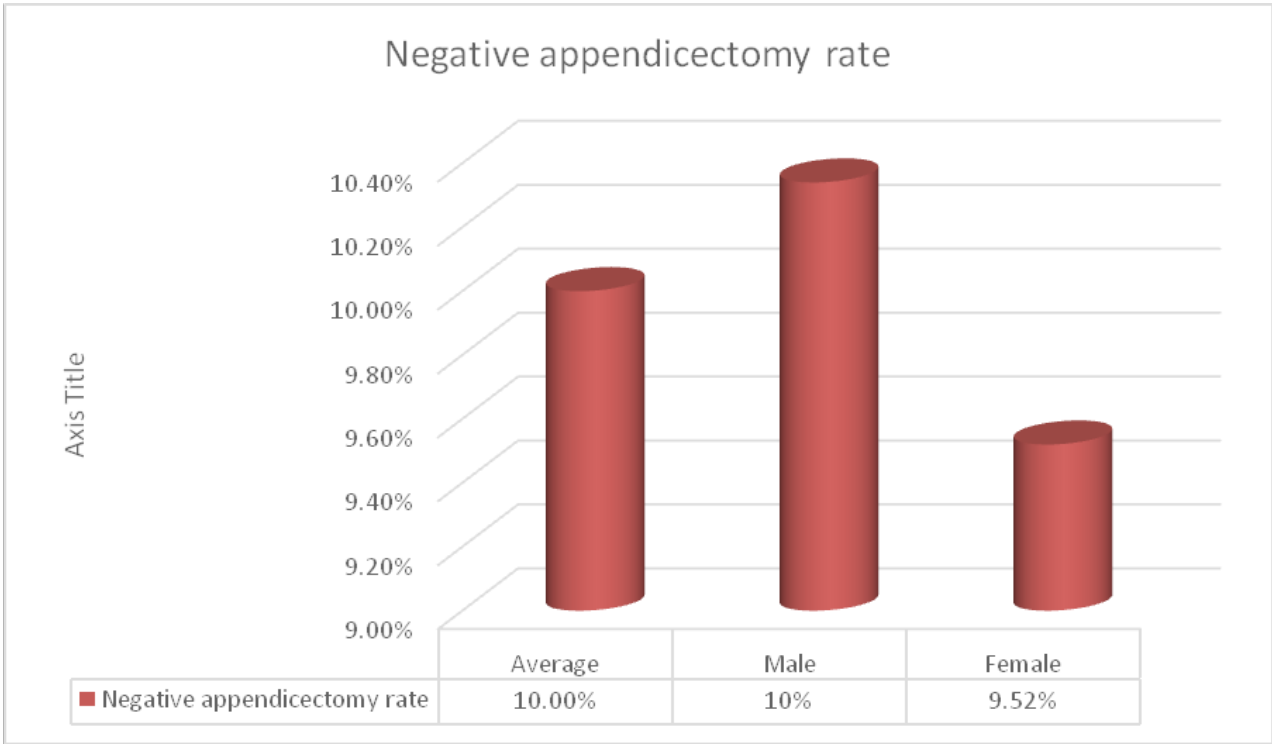


	Yash Score	Tzanakis Score
Sensitivity	94.28%	71.42%
Specificity	93.33%	66.67%
PPV	97.05%	83.33%
NPV	87.50%	50.00%
DA	94%	70%

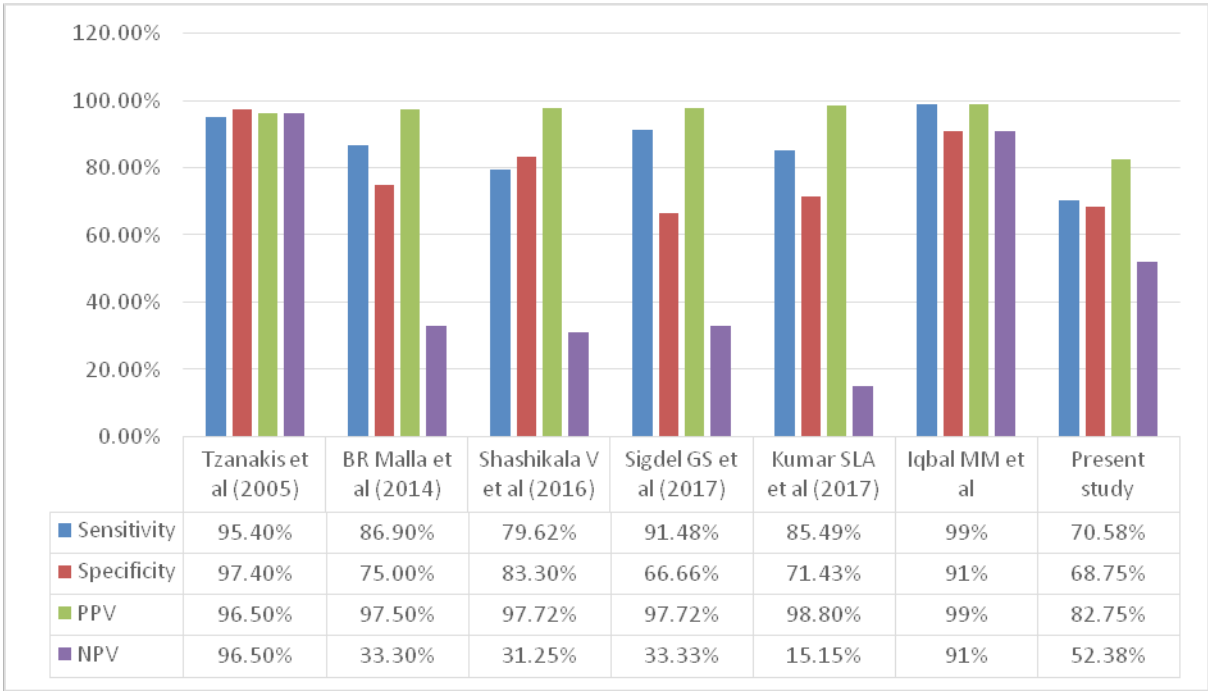
Graph 03: Comparison of the final outcome of Yash scoring system with Tzanakis scoring system:



Graph 04: Negative Appendectomy rate of Yash scoring system:



Graph 05: Negative appendicectomy rate of Tzanakis scoring system:



	Tzanakis et al (2005)	BR Malla et al (2014)	Shashikala V et al (2016)	Sigdel GS et al (2017)	Kumar SLA et al (2017)	Iqbal MM et al	Present study
Sensitivity	95.40%	86.90%	79.62%	91.48%	85.49%	99%	70.58%
Specificity	97.40%	75.00%	83.30%	66.66%	71.43%	91%	68.75%
PPV	96.50%	97.50%	97.72%	97.72%	98.80%	99%	82.75%
NPV	96.50%	33.30%	31.25%	33.33%	15.15%	91%	52.38%

Graph 6: Comparison of final results of Tzanakis scoring system of various studies with our present study

Discussion

Acute appendicitis continues to exist as the most widespread emergency in the world. A delay in making a diagnosis is associated with various complications which increases the morbidity and mortality in patients therefore a prompt and reliable diagnosis of acute appendicitis is mandatory. Furthermore, negative appendicectomy also accounts for a loss of financial resources and is associated with morbidity in 10 to 15% of cases.

Despite big breakthroughs in the imaging field, there remains uncertainty in diagnosing acute appendicitis due to atypical presentations of the disease. It has been repeatedly shown that investigations like USG lack specificity due to its operator dependency whereas investigations like CT scan and MRI are highly-priced demand more advanced equipment and competency. This makes a detailed clinical examination with primary investigations such as leucocyte count as the backbone in diagnosing acute appendicitis. This has compelled many surgeons to use diverse scoring systems for diagnosing acute appendicitis. The clinical evaluation is reliable in 50% to 80% of cases. The evaluation is more complex in the extremes of age and women of reproductive age group due to atypical presentations.

The current study will deal with the evaluation of the Yash scoring system with the Tzanakis scoring system to diagnose acute appendicitis in a simple, reliable, and cost-effective way thereby reducing the negative appendectomy rate and thus morbidity associated with it.

In this study, the sample population consisted of 50 patients out of which 58% were males and 42% were females. The male to female ratio in our study was found to be 1.4:1 which is comparable to the study done by Kumar SLA et al[19] in which the male to female ratio was 1.6:1. A larger part of the study population (50%) was present in the age group of 15 to 29 years. The age group of 30 to 44 years had 26% of patients followed by 24% in the age group of 45 to 60 years. This is comparable to the study done by Kumar SLA et al[19] in which 40% of patients were in the 2nd to 3rd decade of life, 27% of patients in 3rd to 4th decade of life, and only 3% of patients in 5th to 6th decade of life.

All the patients who accomplished the eligibility criteria were subjected to detailed clinical examination, routine hematological investigations, C-reactive protein, USG and were scored based on Yash and Tzanakis scoring system. The decision to operate the patient including patients with scores less than the cut-off value

was based on the clinical assessment and judgment taken by the consultant surgeon. All the patients underwent appendectomy with prior consent and the specimen was subjected to histopathological examination to confirm the diagnosis.

In our study, 82% of the patients were operated by open method whereas 18% of patients were operated by laparoscopy. The study done by Malla BR et al[20] consisted of 200 patients in which 128 patients (64%) underwent appendectomy by an open method and 72 patients (36%) underwent appendectomy by laparoscopy. The most common incision used in open appendectomy was Mc Burney's in about 83% of cases followed by the right Para median which was used in 17% of cases. Similarly, in the study done by Lamture YR et al[17] the most common incision used was Mc Burney's in 94.74% of patients followed by right Para median in 5.26% of cases. In our present study, 35 out of 50 patients (70%) had inflamed appendix intra-operatively. Out of the remaining 15 patients, five patients had enterocolitis, three patients had Meckel's diverticulitis, three patients had the pelvic inflammatory disease (salpingitis), two patients had a ruptured ovarian cyst and two patients had inflamed mesenteric lymph node (with or without pus) as the intra-operative findings. Shashikala V et al[14] in her study had five out of 50 patients with an alternative diagnosis; out of which one patient had enterocolitis and four patients had a pelvic inflammatory disease. Another study was done by Kumar SLA et al[19] his study also reported six patients with alternative diagnoses in which three patients had salpingitis, two patients had an ovarian cyst and one patient had Meckel's diverticulitis.

The new Yash score described by Lamture YR et al [17] in 2017 has a significant role in identifying acute appendicitis. It differs from earlier scoring systems by including various parameters such as C-reactive protein, leukocyte counts, USG, and clinical data. A score of seven or more in patients was considered as acute appendicitis and such patients were subjected to operative intervention.

In our study, out of ten parameters, tenderness in the right iliac fossa was the commonest sign seen in 100% of patients. The other two signs i.e. rebound tenderness and hyperesthesia in Sherren's triangle was seen in 82% and 26% of patients respectively. The most common symptom was fever which was present in 88% of cases followed by nausea or vomiting which was found in 86% of the cases. Anorexia was seen in 72% of patients, whereas 68% of patients gave a history of migratory right iliac fossa pain. Out of the three investigations included in the scoring system, leucocytosis defined as WBC count more than 10000/mm^3 was present in 80% of cases. C-reactive protein with a value of more than 15mg/dl was present in 28% of cases with USG showing features of appendicitis in only 46% of cases.

In the present study, 34 patients had a score of seven or more, and16 patients who had a score of less than seven according to the Yash score.

Out of the 34 patients who scored seven or more, there were 33 patients with features of appendicitis on histopathological examination whereas only one patient hada histologically normal appendix with no features of inflammation.

Similarly, out of 16 patients who scored less than seven, there were 14 patients with a histologically normal appendix with no features of inflammation and only two patients with features of appendicitis on histopathology.

The sensitivity and specificity of the Yash scoring system in the present study were found to be 94.28% and 93.33% respectively. It had PPV and NPV of 97.05% and 88.50% respectively. The overall diagnostic accuracy of the Yash scoring system in our study was found to be 94%. The following results are comparable to the single original study done by Lamture YR et al[17] in which the sensitivity, specificity, PPV, and NPV was 99.48%, 92.86%, 99.48%, and 92.85% respectively. The diagnostic accuracy of the Yash score reported by Lamture YR et al was 98.56%.

The negative appendicectomy rate (NAR) of the Yash scoring system in the present study was found to be zero percent in males and 4.76% in females. This discrepancy in NAR was due to the high probability of other possible diagnoses in females of reproductive age group such as pelvic inflammatory diseases and ovarian cyst. The overall NAR observed for the Yash scoring system was 2% which is way lower than the accepted rate of 15 to 25%. In the study done by Lamture YR et al[17], the NAR was found to be 6.69% which is comparable to our study.

Tzanakis et al [13], in 2005 revealed a more comprehensible system to help in making the diagnosis of appendicitis. It includes four parameters comprising of specific signs, laboratory and radiological investigations such as right iliac fossa tenderness, rebound tenderness

over the right iliac fossa, leucocytosis (WBC count>12,000/mm^3), and USG. A score of 8 or more is considered as acute appendicitis.

In our study, out of the four parameters present in the scoring system, tenderness in the right iliac fossa was the commonest sign seen in 100% of patients whereas rebound tenderness and leucocytosis was found in 82% and 68% of the patients respectively. USG showed features of appendicitis in only 46% of cases.

In the present study, 30 patients had a score of eight or more, and 20 patients who had a score of less than eightaccording to the Tzanakis score.

The 30 patients who scored eight or more had 25 patients with features of appendicitis on histopathology whereas 5 patients had a histologically normal appendix with no features of inflammation.

Similarly,20 patients scored less than eight out of which there were 10 patients with a histologically normal appendix with no features of inflammation and 10 patients with features of appendicitis on histopathology.

The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of the Tzanakis scoring system in our study was found to be 71.42%, 66.67%, 83.33%, 50.00%, and 70%respectively. The low sensitivity and specificity rate was due to the presence of high false-negative and false-positive results.

The study done by Tzanakis et al [13] in 2005 had a sensitivity of 95.4%, a specificity of 97.4%, PPV of 96.5%, NPV of 96.5%, and diagnostic accuracy of 96.5% which is much higher as compared to our present study. This difference may occur due to low sample size, ethnic variation, and other demographic factors such as diet.

The study done by Shashikala V et al[14] in 2016 reported a sensitivity of 79.62%, a specificity of 83.3%, PPV of 97.72%, and NPV of 31.25%which were comparable to our present study. The study done by Iqbal MM et al[15] in 2018 had results similar to that of Tzanakis et al [13] with the sensitivity of 99%, a specificity of 91%, PPV of 99%, NPV of 91%,and diagnostic accuracy of 95%.

The study was done by Sigdel GS et al [16] and Kumar SLA et al [19] in 2017 had a specificity of 66.66% and 71.43% respectively which was comparable to our study whereas the NPV of both the studies was lower than our present study. Both studies had a sensitivity and PPV higher than our present study but the difference is not significant.

Similarly, the study done by BR Malla et al[20] in 2014 had sensitivity, specificity, PPV, and NPV of 86.9%, 75%, 97.5%, and 33.3% respectively. The outcome of the Tzanakis scoring system in the study conducted by Malla BR et al was comparable to our present study.

The negative appendicectomy rate (NAR) of the Tzanakis scoring system in the present study was found to be 10.34% percent in the males and 9.52% in females. The overall NAR observed for the Tzanakis scoring system was 10%.

The negative appendicectomy rate in our present study for the Tzanakis Scoring system was comparable to NAR obtained in the studies done by Shashikala V et al [14](12%) and Iqbal MM et al [15](10.30%).

The result of the Yash scoring system as compared to the result of the Tzanakis scoring system in our present study reveals that the Yash scoring system had a better outcome than the Tzanakis scoring system and was more efficacious than Tzanakis scoring system in diagnosing acute appendicitis. The disadvantage of the Tzanakis scoring system is that it does not include clinical symptoms such as fever, nausea and vomiting, anorexia, migratory right iliac fossa pain, and supportive investigations such as CRP which augments the accuracy of the scoring system. Another factor for the low specificity of the Tzanakis score is that it gives the highest weightage to ultrasonography in its scoring system which has variable sensitivity and specificity due to inter-observer bias.

The negative appendectomy rate of the Yash scoring system was dramatically lower than that of the Tzanakis scoring system.

Conclusion

- The Yash scoring system had sensitivity, specificity, PPV, NPV, and DA of 94.28%, 93.33%, 97.05%, 88.50%, and 94% respectively.
- The overall negative appendicectomy rate of the Yash scoring system was 2%.
- Similarly, the Tzanakis scoring system had sensitivity, specificity, PPV, NPV, and DA 71.42%, 66.67%, 83.33%, 50.00%, and 70% respectively.

- The overall negative appendicectomy rate of the Tzanakis scoring system was 10%.
- Thus, our study reveals that the Yash scoring system is a valuable and plausible modality in detecting acute appendicitis and reducing NAR due to its outstanding outcome regarding its sensitivity, specificity, PPV, NPV, and diagnostic accuracy when compared to Tzanakis scoring system.
- The study also shows that the Yash scoring system is a better tool to avoid unnecessary operations due to its exceptionally low negative appendectomy rate thus lowering morbidity in patients of acute appendicitis and thereby lowering the cost of treatment and prevention of misuse of valuable resources and manpower.

Ethical Clearance: Taken from institutional ethics committee.

Source of Funding: Self.

Conflict of Interest: Nil.

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