International Surgery Journal
Goel KS et al. Int Surg J. 2018 Nov;5(11):3489-3495
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20184614

Original Research Article

Evaluation of validation of Anderson score for diagnosis of acute appendicitis by histopathology

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Received: 29 August 2018
Accepted: 03 September 2018

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ABSTRACT

Background: Appendicectomy is a very common operation performed. Removing normal appendix leads to multiphasic problems. Furthermore, appendix has proved to be a useful structure in reconstructive surgeries. We are going to evaluate validation of Anderson score for diagnosis of acute appendicitis and confirm the result by histopathology.
Methods: This prospective observational study was performed in Surgery Department in SGT Medical College, Gurugram, Haryana. Total patients were 100. A detailed history was taken, clinical examination and investigations were done. All patients were subjected to Anderson score. Patients were operated. Appendix was sent for Histopathology examination. Analysis of the data was done by SPSS software version 23. Sensitivity, specificity, positive predictive value and negative predictive values were found out. Chi square test was duly applied.
Results: In 70 patients, Anderson score was >8, was in favour of acute appendicitis. It means these patients should require surgery. In 30 patients score was <8. Most common histopathology finding was acute appendicitis then diffuse suppurative appendicitis followed by gangrenous appendicitis still followed by diffuse suppurative appendicitis with peri appendicitis.
Conclusions: we have found out that if Anderson score is ≥8, appendicectomy should be done. But if Anderson score is <8, as per Anderson scoring system, appendicectomy should not be done, but we should not go by this. We should review the patient, further investigations should be carried out, senior surgeon's opinion should be taken, and then final decision should be taken.

Keywords: Appendicectomy, Anderson score, Evaluation, Histopathology

INTRODUCTION

Appendix is basically a vestigial organ. When it gets inflamed it results in acute appendicitis which is a very common condition. It is a very common cause of pain in right lower quadrant.[1] Appendicectomy is a very common operation performed. Because of advances in ultrasonography and CT Scanning there is improvement in diagnosis of appendicitis, but still clinical observation and experience of surgeon matters a lot. This is a common disease of childhood and early adult life with maximum incidence in teens and early twenties.[2]

Incidence decreases after middle age. The disease occurrence is same in male or female before fifteen years of age. After that male preponderance is more than female. After twenty-five years the greater incidence in male declines.[3] Appendix occurs in various anatomical

positions as depicted in Figure 1. Various possible etiological factors accounted for acute appendicitis are like this diet (low residue diet), social status (high middle class, upper class), residence (European, American and Austrialin), familial susceptibility, obstruction of the lumen of the appendix with faecolith, foreign body, round worm or thread worm or a stricture and indiscriminate use of purgatives are all incriminated.

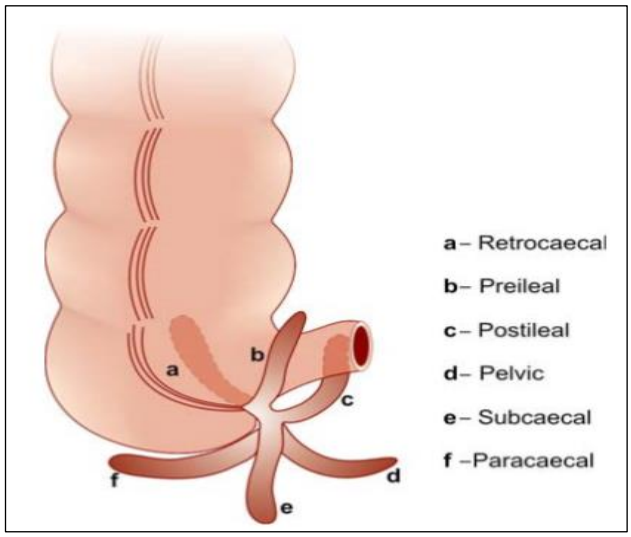

Figure 1: Different anatomical positions of the appendix.

Bacteria incorporated in acute appendicitis are *E coli*, *Pseudomonas*, *Klebsiella* and anaerobes. A careful history must be taken. If the patient gets pain around the umbilicus or in the epigastrium in the beginning and later on this pain shifts to the right iliac fossa, he is undoubtedly suffering from an acute appendicitis. The pain is dull aching in character in non-obstructive type of appendicitis, whereas this is of colicky nature in obstructive appendicitis. Pain is followed by nausea and vomiting along with anorexia depending on the degree of distension of the appendix.

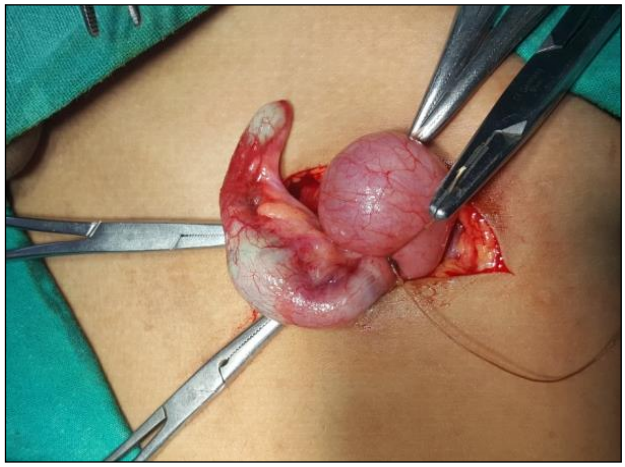

Figure 2: On table demonstration of appendicolith.

Fever is almost always associated with this condition. The sequence of symptoms, viz. pain, vomiting and temperature, is known as 'Murphy's syndrome'. So far as the bowel habit is concerned constipation is the usual accompaniment, but there may be diarrhoea in case of acute pelvic appendicitis or with appendicular abscess. Examination reveals presence of hyperaesthesia in Sherren's triangle, tenderness at McBurney's point, muscle guard and rebound tenderness over the appendix.

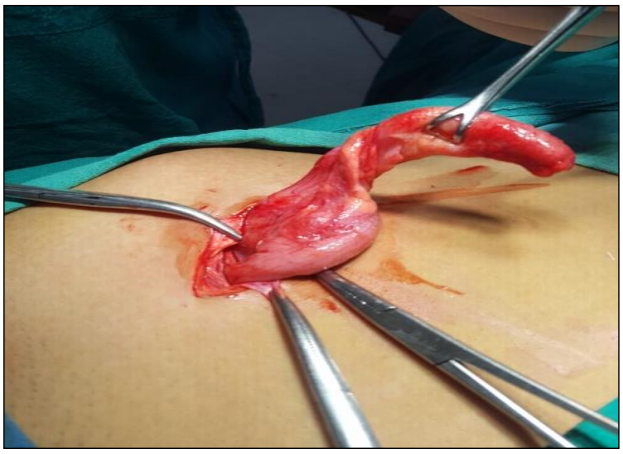

Figure 3: Appendix showing inflammation near tip.

Positive Rovsing's sign is a definite diagnostic clue and should always be looked for.[4] Although acute appendicitis is most common abdominal surgical emergency, many times the diagnosis can be very difficult.

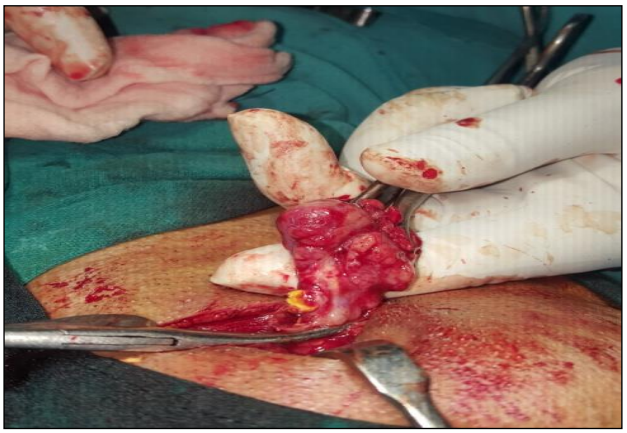

Figure 4: Laparotomy showing perforted appendix near base.

A number of common conditions like: right ureteric colic, right sided acute pyelonephritis, ruptured ovarian follicle (mittelschmerz), twisted tight ovarian cyst, gastroenteritis, enterocolitis, intestinal obstruction, acute cholecystitis, acute pancreatitis, ruptured liver abscess, regional ileitis, carcinoma of the cecum, mesenteric infarction, Henoch-Schonlein purpura, blood dyscrasias and abdominal crisis of porphyria, mimic this disease.

Investigations

TLC is raised, USG is done basically to find other disease like ovarian cyst, ectopic pregnancy, ureteric stone, appendicular abscess or mass. In investigations, CT is required if clinically appendicitis is not sure. C- reactive protein, even though not specific, but increases in acute appendicitis. C- reactive protein increases within hours of an acute injury or the onset of inflammation and may reach as high as 20 times the normal levels.

Should perforation take place, the outlook temporarily improves with disappearance of pain, but very soon the features of spreading peritonitis appears. Removing normal appendix leads to multiphasic problems e.g. financial burden on patient, health department, depletion of health resources, increased chances of involvement of doctor by patient in consumer court and fall in reputation of upcoming surgeons who has to set his carrier especially in private setup.

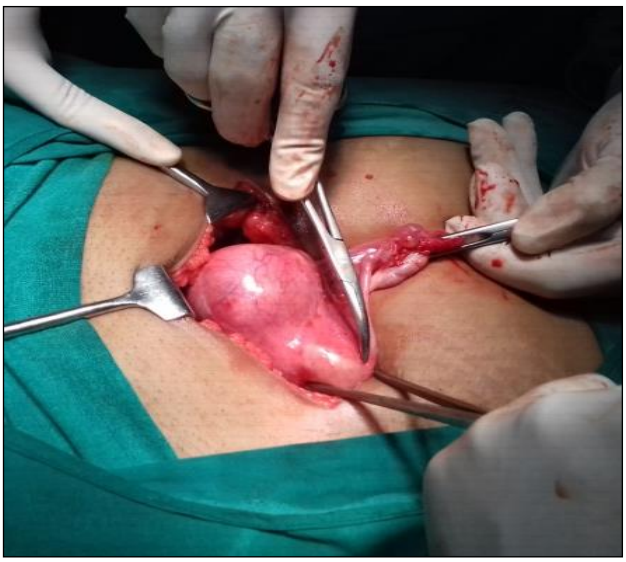

Figure 5: Coiled and tortuous appendix with distal inflammation.

Furthermore, appendix has proved to be a useful structure in reconstructive surgeries of biliary tract, urology and tubal surgeries. A number of scoring system have been used to find the diagnosis of appendicitis correctly e.g. Alvarado scoring for appendicitis, Kalam modified Alvarado scoring system, RIPASA scoring system, Tzanakis scoring system and Anderson scoring system etc.[5] Elaborate researches have been carried out to find clinical, laboratories and radiological parameters and many scores have been found out for correct diagnosis of acute appendicitis.

We are going to evaluate validation of Anderson score for diagnosis of acute appendicitis and confirm the result by histopathology for the sole purpose of making a correct diagnosis and reaching the ultimate motive that is to save a healthy appendix and remove a diseased one.

METHODS

This study was a prospective observational study performed in Surgery Department in SGT Medical College, SGT University, Budhera, Gurugram, Haryana, over a period of 2 years from January 2016 to January 2018.

Selection of subjects (cases)

A total of 100 patients were studied. Informed consent was taken for examination and investigations giving due respect to maintain the patient's privacy and keep them comfortable.

Data collection

The patients were taken from outpatient department and emergency department of General surgery department. A detailed history about site of pain, migration of pain, nausea, vomiting and fever was taken. Clinical examination regarding tenderness, rebound tenderness, Psoas's sign, Rovsing's sign and Obiturator's sign were done.

Investigation done in all patients included Hb, BT, CT, TLC, DLC, Blood Urea, Serum Creatinine, HCV, HIV, HBSAg, CRP and USG abdomen. X-Ray Chest PA view and ECG were done in relevant cases for fitness for anaesthesia purpose. All patients were subjected to Anderson score. Patients were operated in emergency by incision as required in individual cases. After appendicectomy, appendix was sent for Histopathology examination to confirm the diagnosis. Analysis of the data was done by SPSS software version 23. Sensitivity, specificity, positive predictive value and negative predictive values were found out. Chi square test was duly applied. The conservative patients were discharged after they became alright.

Exclusion criteria

The patient who came with appendicular lump was not taken in this study.

Ethical considerations

The Institutional Ethics Committee's approval for Research on Human Subjects was taken. Throughout the study, strict ethical norms were maintained. Written informed consent was taken from patient in their local language (mother tongue).

Statistical methods

The data were collected properly, and entries were made, and statistical analysis was carried out using statistical SPSS version 23 software by using Chi-square test. Sensitivity, specificity, NPV and PPV were also carried out in each category. Sensitivity is considered as

proportion of persons with the diseases who test positive in the screen. Specificity is the proportion of persons who do not have the disease that test negative in the screening test. The PPV is the proportion of persons who test positive that actually have the diseases. NPV is the proportion testing negative that do not have the disease. Statistically significant p value of less than 0.05 was considered statistically significant. P-value less than 0.01 was considered as statistically very significant and p-value of less than 0.001 was considered as statistically extremely significant.

RESULTS

This prospective observational study was conducted in the Department of General Surgery, SGT Medical College, SGT University, Budhera, Gurugram, Haryana. 100 patients having pain in right fossa and giving history and relevant examination findings suggestive of acute appendicitis were taken for this study.

Table 1: Various parameters used in Anderson score.

Variable	Level	Score
Pain or tenderness in right lower quadrant		+1
Vomiting		+1
Rebound tenderness or muscular defence	Slight	+1
	Moderate	+2
	Strong	+3
WBC Count	10-14.9x109/1	+1
	≥15.0x109/1	+2
Proportion neutrophils	70%-84%	+1
	≥85%	+2
CRP concentration	10-49mg/1	+1
	≥50mg/1	+2
Body temperature	≥38.5*C	+1

Sum 0-4: Low probability. Out-patient follow up if unaltered condition; Sum 5-8: Indeterminate group. Active observation with rescoring/ imaging or diagnostic laparoscopy according to the local tradition; Sum 9-12: High probability. Surgical exploration is proposed.

Table 2: Sex distribution.

Sex	No. of patients	%
Male	66	66
Female	34	34
Total	100	100

Here those patients who presented with appendicular lump were not taken in this study. Investigation done in all patients included Hb, BT, CT, TLC, DLC, blood urea, serum creatinine, HCV, HIV, HBs≥Ag, CRP, USG abdomen, X-ray chest PA view and ECG in relevant cases for fitness for anaesthesia purpose. All patients were subjected to Anderson score. After appendicectomy appendix was sent for Histopathology examination to confirm the diagnosis.

Table 3: Age distribution.

Age in years	No. of patients	%
< 15 years	22	22
15-24 years	29	29
25-34 years	16	16
35-44 yeas	17	17
45-60 years	9	9
>60 years	7	7
Total	100	100

Analysis of the data was done by SPSS software version 23. There were total of 100 patients in this study. 66 (66%) males and 34 (34%) females (Table 2).

28.2 years was the mean age of the patients. The age of most of the patient (67%) was below 35 years, with peak incidence in 15-24 years age group (Table 3).

Table 4: Various symptoms.

Symptoms	No. of patients	%
Pain in right iliac region	100	100
Vomiting	82	82
Anorexia	86	86
Fever	22	44

Table 5: Duration of symptoms.

Duration of symptoms	No. of patients	%
<36 hours	72	72
≥36 hours	28	28
Total	100	100

Positive Rovsing's sign was positive in 22 (22%) patients (Table 6).

Table 6: Various signs.

Signs	No. of patients	%
Tenderness	96	96
Rebound tenderness	58	58
Guarding	78	78
Rovsing 's Sign	22	22

TLC was raised in 80 (80%) patients (Table 7). Raised CRP was present in 88 (88%) patients (Table 8)

Table 7: Total leucocytic count.

Investigation	No. of patients	%
Total leucocytic count ≥11000	80	80
Total leucocytic count <11000	20	20

Table 8: Total CRP.

Investigation	No. of patients	%
CRP ≥ 15	88	88
CRP <15	12	12

Table 9: Values of Anderson score distribution.

Anderson score	No. of patients	%
≥ 8	70	70
< 8	30	30

All patient had pain in right iliac fossa. Vomiting was present in 82 (82%) patients. Anorexia was present in 86 (86%) patients. Fever occurred in 22 (22%) patients (Table 4). 72 (72%) patients had symptoms of duration less than 36 hours. 28 (28%) patients had symptoms of duration more than 36 hours (Table 5). McBurney's point was tender in 96 (96%) patients. Guarding occurred in 78 (78%) patients. Rebound tenderness occurred in 58 (58%) patients.

In 70 (70%) patients, Anderson score (≥8) was in favour of acute appendicitis. It means these patients should require surgery. In 30 patients score was <8. It means these patients should not require surgery (Table 9). In 70 patients where Anderson score was ≥8, in these patients TLC was raised in 59 (84.3%) patients and normal in 11(15.7%) patients. In 30 patients where Anderson score was <8, the TLC was raised in 21 (70%) patients and TLC was normal in 9 (30%) patients (Table 10). The observation is revealing a significant p value of 0.000068 (Table 11).

Table 10: Anderson score and total leucocytic count.

Anderson score	Total No. of patient (%)	WBC <11000	WBC ≥11000
<8	30 (100)	9 (30%)	21 (70%)
≥8	70 (100)	11 (15.7%)	59 (84.3%)
Total	100	20 (20%)	80 (80%)

Table 11: Chi Square test.

	Value	Coefficient of differentiations	P value
Pearson Chi-square possible ratio	15.764	1	0.000068

Of 100 patients of appendicitis, 95 (95%) were operated and confirmed by histopathology.

Table 12: Histopathology study.

Histopathological Diagnosis Types	Total no. of Patients
Conservative Treatment	5
Acute appendicitis	55
Acute diffuse suppurative appendicitis	19
Gangrenous appendicitis	12
Diffuse appendicitis with periappendicitis	9

Conservative treatment was given in 5 patients. Most common histopathology finding was acute appendicitis 55 (55%) patients.Next was diffuse suppurative appendicitis in 19 (19%) patients followed by gangrenous appendicitis in 12 (12%) patients still followed by diffuse suppurative appendicitis with periappendicitis in 9 (9%) patients (Table 12).

In most of the patients (59%) the histopathology was acute appendicitis because most of the patients (72%) presented within 36 hours.

Further the surgeons have a tendency not to delay the operation. 28 (28%) patients presented after 36 hours and probably these were the patients in whom pathology was of severe type i.e. diffuse, gangrenous or diffuse suppurative type. In present study as per Anderson scoring system 70 patients were found to have appendicitis. All these patients proved to be so on histopathology also, there was no false positive case.

Table 13: Anderson score with results.

Anderson score	Total no. of patients	Conservative	Appendicitis (appendicectomy done)
Anderson score<8	30 (100%)	5 (16.7%)	25 (83.3%)
Anderson score≥8	70 (100%)	0	70 (100%)
Total	100 (100%)	5 (5%)	95 (95%)

Out of total of 100 patients, 30 patients had Anderson score of >8. Out of these 30 patients 5 patients were kept on conservative treatment and 25 were operated. These operated patients also revealed appendicitis as per histopathology (Table 13). Thus, by Anderson scoring system 25 patients who were supposed not to have

appendicitis were actually having appendicitis as per histopathology findings. These 25 patients did not reveal appendicitis as per Anderson scoring system. This is very significant statistically with a p value of <0.05. The specificity in Anderson scoring system in this study is 100%, sensitivity 73.7%, positive predictive value 100% and negative predictive value 16.67%.

Thus, we have found out that if Anderson score is ≥8, appendicectomy should be done, it should be done because in our 70 patients who had Anderson score of ≥8 and in all appendicectomy was done, all were confirmed by histopathology to be appendicitis. But if Anderson score is <8 says that appendicectomy should not be done, but we should not go by this.

We should review the patient, further investigations should be carried out, senior surgeon's opinion should be taken, and then final decision should be taken because in 25 patients in whom Anderson score was negative but appendicectomy was carried out all got confirmed for appendicitis by histopathology.

DISCUSSION

Appendicitis is a very common cause of pain in right lower quadrant. Appendicectomy is a very common operation performed. Because of advances in ultrasonography and CT Scanning there is improvement in diagnosis of appendicitis, but still clinical observation and experience of surgeon matters a lot. Though no age is exempt, it is rare before the age of 2 years. It becomes increasingly common during childhood and adolescence and the maximum incidence is noticed between 20 and 30 years.

Thereafter the incidence gradually drops. Involvement of early age in this disease is because of the increased amount of submucosal lymphoid tissue in the appendix which is responsible for inflammatory and immunological response to the infections. There is great importance of detailed history and clinical examination.

The sensitivity, specificity, positive predictive value and overall accuracy on clinical examination has been found to be 63.2%, 81.8%, 62.2% and 70.8% respectively. Sometimes diagnosis is not certain and in older patients in whom acute diverticulitis and neoplasms are differential diagnosis CECT is of importance. In CT in appendicitis there will be appendix of size more than 6 mm with intramural gas or standing of the periappendicial fat. CECT scan has a sensitivity of 94% and specificity of 95% for diagnosis of acute appendicitis.[6]

In present studies the age Range is 12 years to 64 years. Several studies have shown similar or different values of age ranges. Addiss et al found that the age range 10 to 19 years. Emre et al revealed age range of 18 to 67 years.[7,8] In present study the male to female ratio is 1.94:1. Similar results were given by Shah et al which showed male to female ratio 1.86:1.[9] Debbalon et al has shown female preponderance, male to female ratio 1:1.2. No definite cause can be attributed to male preponderance, more appendicolith in males may be the reason.[10] The duration of symptoms in present study was <36 hours in 72 (72%) patients. Erdem et al revealed duration of <48 hours in 58% patients.[11]

In present study right, iliac fossa pain was present in 100%, vomiting 82%, anorexia 86% and fever in 22% parents. Similar results were given in studies of Nshuti et al and almost 4 similar results were given by Burger et al.[12,13] The variation in results of anorexia, vomiting, nausea is due to degree of distension of acutely inflamed appendix in addition to subjective susceptibility of patient to nervous reflex mechanism.

In present study tenderness in right iliac fossa was present in 96(96%) patients, rebound tenderness in 58(58%), guarding in 78(78%) and Rovsing sign in 22(22%) patients. Similar results were found in studies of Samad et al.[14]

In our studies TLC was raised in 80(80%) patients. In study by Samad et al (2009)14 TLC was raised in 72% patients. There have been studies like Chamisa et al where TLC was raised in 33.9% patients. It has been found that increased TLC is a very sensitive test for acute appendicitis. But there are cases that TLC may be normal in very severe appendicitis or perforation.[15]

In our studies CRP was raised in 88(88%) patients. Similar results were found in studies of Shafi et al, Yokoyama S et al. Acceptable negative appendicectomy rate should ideally be less than 20%, with the introduction of CT for the diagnosis of acute appendicitis the negative appendicectomy rate should be less than 5%. If the rate is more it means we are over doing it. If the rate is very less it means we are too much waiting, so perforation might occur.

If the treatment is delayed, the chances of post – operative sepsis increases, and the hospital stay also become longer. Further the rate of perforation also increases by 5% every 12-hour delay. This of course starts after 36 hours of onset of appendicitis.[16] In present study the negative predictive rate is 0. Park et al in a very large series of 2763 patients had a negative appendicectomy rate of 5.8%.[17] Jawaid et al had negative appendectomy rate of 7%.[18] Kanumba et al had negative appendicectomy rate 33.1%.[19] The Zero negative appendicectomy rate may be due to our meticulous check at all levels.

In present study as per Anderson scoring system 70 patients were found to have appendicitis. All these patients proved to be so as per histopathology also, there was no false positive case. Out of total of 100 patients 30 patients had Anderson score of <8. Out of these 30

patients, 5 patients were kept on conservative treatment and 25 were operated. These operated patients also revealed appendicitis as per histopathology. Thus, by Anderson scoring system 25 patients who were supposed not to have appendicitis were actually having appendicitis as per histopathology findings. These 25 patients did not reveal appendicitis as per Anderson scoring system. This is very significant statistically with a p value of <0.05. The specificity in Anderson scoring system in this study is 100%, sensitivity 73.7%, positive predictive value 100% and negative predictive value 16.67%.

Thus, we have found out that if Anderson score is ≥8, appendicectomy should be done, it should be done because in our 70 patients who had Anderson score of ≥8 and in all appendicectomy was done, all were confirmed by histopathology to be appendicitis. But if Anderson score is <8, as per Anderson scoring system, appendicectomy should not be done, but we should not go by this. We should review the patient, further investigations should be carried out, senior surgeon's opinion should be taken, and then final decision should be taken because in 25 patients in whom Anderson score was negative but appendicectomy was carried out all got confirmed as appendicitis by histopathology.

CONCLUSION

We have found out that if Anderson score is ≥8, appendicectomy should be done. But if Anderson score is <8, as per Anderson scoring system, appendicectomy should not be done, but we should not go by this. We should review the patient, further investigations should be carried out, senior surgeon's opinion should be taken, and then final decision should be taken.

ACKNOWLEDGEMENTS

Authors would also like to acknowledge Dr. Mrs. Sapna Goel MD Pathology DNB, Assistant Professor, Department of Pathology, SGT Medical Collge, SGT University, Budhera, Gurugram, Haryana, for doing all histopathology examination and helping the authors in all aspects of writing and this paper.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Maa J, Kirkwood KS. Appendix. In: Townsend CM, Beauchamp RD, Evers BM, Mattox KL, eds. Sabiston Textbook of Surgery. 18th ed. Philadelphia: Elsevier. 2008:1333-47.
2. Rothrock SG, Pagane. Acute appendicitis in children, emergency department diagnosis and management. Ann Emerg Med. 2000;36-9.
3. Williams NS, Christopher JK. Bulstrode, O'Connell PR, Raton B. Bailey and Love's Short Practice of Surgery. 26th edition. CRC Press Taylor and Francis Group; 2013.
4. Das S. A manual on clinical surgery. 11th edition, S Das Publication; 2008.
5. Bhat SM. SRB's manual of surgery. 5th edition. New Delhi: Jaypee Brothers Medical Publishers; 2016.
6. Saha ML. Bedside clinics in surgery. 3rd edition, New Delhi; Jaypee Brothers Med Publishers (P) Ltd; 2018.
7. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendicectomy in the United States. Am J Epidimiology. 1990;132:910-25.
8. Emre A, Akbulut S, Bozdag Z, Yimaz, Kanilioz M, Emre R, et al. Routine histopathological examination of appendectomy specimen: retrospective analysis of 1255 patients. Int Surg. 2013;98(4):354-62.
9. Shah WA, Khan CA, Malik SA, Waqas A, Bhutta IA. Accuracy of the modified Alvarado score in diagnosis of acute appendicitis in adults. Professional Med J. 2010;17(4):546-50.
10. Debbalon PO, Chalumeau C, Facy O. CT scan and appendicitis: inadequate population. J Surg Educ. 2007;64(2):64.
11. Erdem H, Cetinkunar S, Das K, Reyhan E, Deger C, Aziret M, et al. Alvarado, Eskelinen, Ohhman and Raja Isteri Penigran Anak Saleha Appendicitis score for diagnosis of acute appendicitis. World J Gastroental. 2013;19(47):9057-62.
12. Nshuti R, Kruger D, Luvhengo TE. Clinical presentation acute appendicitis in adults at the Chris Hani Baragwanath academic hospital. Int J Emerg Med. 2014;7(1):12.
13. Burger TO, Torbert HC. Problems in the diagnosis of acute appendicitis. Ca West Med. 1939;50(1):7-11.
14. Samad A, Kumar B, Khanzada TW, Lohana D. Appropriate cut off value of Alvarado score for patients undergoing appendectomy in Isra University Hospital, Hyderabad. Israel Med J. 2009;1(2):36-9.
15. Chamisa I. A clinicopathological review of 324 appendices removed for acute appendicitis in Durban, South Africa: a retrospective analysis. Ann R Coll Surg Engl. 2009;91(8):688-92.
16. Bickell NA, Aufess AH, Rajos M, Bodian C. How time affects the risk of rupture in appendicitis. J Am Coll Surg. 2006;202:401-6.
17. Park JS, Jeong JH, Lee JI, Lee JH, Park JH, Moon HJ, et al, Accuracies of diagnostic methods for acute appendicitis. Am Surg. 2013;79(1):101-6.
18. Jawaid A, Asad A, Motiei, Munir A, Bhutto E, Choidhary H, et al. Clinical scoring system: a valuable tool for decision making in cases of acute appendicitis. J Pak Med Assoc. 1999;49(10):254-9.
19. Kanumba ES, Mabula JB, Rambaau P, Chalya PL. Modified alvarado scoring system as diagnostic tool for acute appendicitis at Bugando Medical Centre, Mwanza, Tanzania. BMC Surg. 2011;11:4.

Cite this article as: Goel KS, Goel S. Evaluation of validation of Anderson score for diagnosis of acute appendicitis by histopathology. Int Surg J 2018;5:3489-95.