

Appraisal of Various Predictors for Complicated Appendicitis in Adults; A Comparative Study Between Complicated and Non-Complicated Appendicitis

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Research article

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Abstract

Background: Acute appendicitis is the most common non traumatic surgical abdominal emergency, and is the first operation done by most of the general surgeon during their training period. The most important aspect in the management of acute appendicitis, is early diagnosis and intervention to avoid the development of complications.

Patients and methods: This prospective study included 184 patients diagnosed with acute appendicitis who were grouped into complicated and non- complicated appendicitis. Both groups were compared to detect predictors for complicated appendicitis to prevent delay management.

Results: About 82.6% of our patients were below 30 years (mean: 23.8 years) and 59.2% were females. Histopathology confirmed acute appendicitis in 86.5 %, chronic appendicitis in 12.5%, and normal appendix in 1.1%. About 81.5% have ALVARADO score equal or greater than 7. Complicated appendicitis was diagnosed in 23.37% of patients. There was a significant correlation between complicated appendicitis and gender, rebound tenderness, elevated temperature, elevated WBC, shift to left of WBC and Modified Alvarado Scoring (P values 0.000,0.002,0.001,0.000,0.000, and 0.006), other parameters showed no significant correlations.

Conclusion: The rate of complicated appendicitis should be reduced to decrease the associated morbidity, the presence of rebound tenderness, fever, high WBC count and shift to left, a score of 7 or more by modified ALVAADO score, and male sex are highly suggestive. The presence of these factors mandates early and prompt intervention.

Introduction

Acute appendicitis is the most common non traumatic surgical abdominal emergency, and is the first operation done by most of the general surgeon during their training period. The disease is very familiar for the general population also, and many of the signs and symptom are well known. The life time for acute appendicitis is around 7-9%, with slight higher risk for males. [1-5]

The pathogenesis of acute appendicitis is well understood, it usually start with increase mucous production, luminal obstruction, bacterial overgrowth, leading to increase on the appendiceal wall, impairment of the blood supply, ischemia, and gangrene and perforation if left untreated. [6]

The most important aspect in the management of acute appendicitis, is early diagnosis and intervention to avoid the development of complications. Appendectomy appears to be safe procedure for cases of acute appendicitis, many clinical trials have suggested the use of antibiotics alone as a primary line for the management of acute appendicitis in carefully selected patients, and however this may lead to delay in the surgical intervention and the development of complicated appendicitis in some patients. [6]

Complicated appendicitis include the development of phlegmonous appendicitis, gangrenous appendix, perforated appendix, abscess formation and generalized peritonitis. This eventually leads to a considerable morbidity including severe intraperitoneal sepsis, increasing readmission rates, and sometimes even mortality if not treated appropriately. [2, 4, 7]

Acute appendicitis is usually diagnosed on the basis of clinical settings depending on the symptoms and signs, evidence of raise inflammatory markers on blood tests, and sometimes with the aid of different imaging modalities. There are many scoring systems which correlate many clinical points for a possible more accurate diagnosis of acute appendicitis and to reduce the rate of both complicated appendicitis and performing normal appendectomies. [3]

In the last decades, the diagnosis and the management of appendicitis has improved dramatically, this is due to advancement of the diagnostic tool, better access to the health care, more available advanced imaging modalities such as CT scan and the wide use of laparoscopy for diagnosis and surgery. [7]

The management of acute appendicitis is appropriate and timely surgical intervention, complicated appendicitis usually require preoperative optimization of the general condition including fluid therapy and broad spectrum antibiotics, and may require longer duration of hospital stay. Surgery, in the form of appendectomy, can be done adopting the open or the laparoscopic technique, intraperitoneal sepsis should be dealt with, abscesses evacuated, and some patients may need copious irrigating. [4]

Patients And Methods

This prospective study included 184 patients who were admitted to the surgical emergency department complaining from right lower quadrant abdominal pain, detailed history was taken from each patients regarding the symptoms mainly migratory pain, anorexia, nausea and vomiting, any previous attacks, and menstrual history, followed by physical examination to detect any change in body temperature, the pulse and blood pressure, abdominal tenderness right lower quadrant(RLQ) abdominal tenderness, rebound tenderness, and the presence of extra signs such as Rovsing's sign (RLQ abdominal pain on deep palpation of the left lower quadrant), obturator sign(pain elicited on hip internal rotation) and rectal tenderness. Patients then were sent for urinalysis and blood count to detect any urinary abnormalities as hematuria and elevated WBC and shift to left of WBC (increase in the number of immature cell types) indicating rapid consumption of the neutrophils. Some patients were sent for ultrasound examination to detect any gynecological or urinary abnormalities, then patients were grouped according to the ALVARADO and modified ALVARADO score depending on the clinical stats and lab findings into those having score below 7 and those equal or above 7. Patients who had score below 7 were labelled as unlikely to have acute appendicitis unless they were diagnosed by ultrasound, then open surgery were performed for the patients in the form of conventional appendectomy and the appendix were sent for histopathological examination.

Statistical analyses:

Data were described as frequencies and percentages for the numerical ones, and the mean and standard deviation for the categorical ones. Patients were grouped into 2 groups depending whether there is complicate appendicitis or not, complicated appendicitis was defined as the presence of phlegmonous appendicitis, gangrenous appendix, perforated appendix, abscess formation and generalized peritonitis. Then various clinical and laboratory findings were correlated based on this grouping using the Statistical Package for Social Sciences (SPSS; IBM version 25), p value were calculated using the Pearson chi square test and the Fischer's Exact test, values less than 0.05 were considered significant.

Ethical registration: Ethical approval was granted from the Research Registration Unit at College of Medicine, University of Duhok with a registration number: 3N at 6-12-2020.

Results

Appendicitis is more common in the young age groups, about 82.6% of our patients were below 30 years with a mean age of (23.8 years) of the involved patients, 59.2% were females and the majority had single attack of pain with a single admission to the hospital. Table 1.

Table 1: Various charecteristics of the patients who were included in the study.

Category	Subcategory	Frequency	percentage
Age of the patient (M;SD)		23.80	7.526
Range: 18-51			
Age groups	Less than 30 years	152	82.6
	More than 30 years	32	17.4
Gender	Male	75	40.8
	Female	109	59.2
Duration of symptoms	Less than 24 hours	80	43.5
	More than 24 hours	104	56.5
Frequency of attacks	Single attack	134	72.8
	Multiple attacks	50	27.2
Number of admissions	Single admission	147	79.9
	Multiple admissions	37	20.1

The important points in the medical history, the clinical examination, and the laboratory findings are listed in table 2. The diagnosis of acute appendicitis was confirmed by histopathology in 86.5 %, 12.5% had chronic appendicitis, and in 1.1% the appendix was normal.

Table 2: The findings during the clinical examination, laboratory tests, operative findings, and the histopathological examination.

Category	Subcategories	Status	Frequency	Percentage
Symptoms	Migration of pain	No	83	45.1
		Yes	101	54.9
	Anorexia	No	51	27.7
		Yes	133	72.3
	Nausea & vomiting	No	34	18.5
		Yes	150	81.5
Signs	RIF tenderness	No	3	1.6
		Yes	181	98.4
	Rebound tenderness	No	38	20.7
		Yes	146	79.3
	Elevated temperature	No	70	38.0
		Yes	114	62.0
	Extra signs*	No	39	21.2
		Yes	145	78.8
Laboratory	Elevated WBC count	No	40	21.7
		Yes	144	78.3
	Left shift of WBC**	No	92	50.0
		Yes	92	50.0
Operative findings	Normal appendix		6	3.3
	Inflamed appendix		135	73.4
	Highly inflamed appendix		32	17.4
	Perforated appendix		7	3.8
	Gangrenous appendix		4	2.2
Histopathology	Normal appendix		2	1.1
	Acute appendicitis		137	74.5
	suppurative / gangrenous appendicitis		22	12.0
	Chronic appendicitis		23	12.5

*Such as Rovsing's sign, obturator sign, and rectal tenderness.

** Young/immature white blood cells.

The modified Alvarado score system group patients according to the clinical and the laboratory tests to those who most probably have appendicitis and those with less probability, a cut value of 7 were considered for this classification. About 81.5% of our patients have a high probability of having acute appendicitis and their scores were equal or greater than 7, figure 1.

Complicated appendicitis were considered in the presence of phlegmonous appendicitis, gangrenous appendix, and perforated appendix. Patients were grouped into 2 groups based on this into those with complicated and those with non-complicated appendicitis, 23.37% of the patients were diagnosed as having complicated ones. Figure 2.

Most patients with complicated appendicitis had a modified Alvarado score equal or greater than 7, this correlation is shown in figure 3.

The correlations between different predictors for each group of patients is done using the Pearson chi square test and the Fischer's Exact test, table 3.

Table 3: The correlation of various clinical, laboratory, operative and histopathological predictors between each of groups of patients.

Category	Subcategories	Complicated appendicitis		Sig. (2-sided)
		No (n=141)	Yes (n=43)	
Age groups	Less than 30 years	116(82.3%)	36(83.7%)	1.00*
	More than 30 years	25(17.7%)	7(16.3%)	
Gender	Male	35(24.8%)	40(93.0%)	0.000*
	Female	106(75.2%)	3(7.0%)	
Duration of symptoms	Less than 24 hours	62(44.0%)	18(41.9%)	0.807*
	More than 24 hours	79(56.0%)	25(58.1%)	
Frequency of attacks	Single attack	101(71.6%)	33(76.7%)	0.562*
	Multiple attacks	40(28.4%)	10(23.3%)	
Number of admissions	Single admission	111(78.7%)	36(83.7%)	0.524*
	Multiple admissions	30(21.3%)	7(16.3%)	
Migration of pain	No	69(48.9%)	14(32.6%)	0.079*
	Yes	72(51.1%)	29(67.4%)	
Anorexia	No	43(30.5%)	8(18.6%)	0.173*
	Yes	98(69.5%)	35(81.4%)	
Nausea & vomiting	No	29(20.6%)	5(11.6%)	0.262*
	Yes	112(79.4%)	38(88.4%)	
RLQ tenderness	No	2(1.4%)	1(2.3%)	1.00**
	Yes	139(98.6%)	42(97.7%)	
Rebound tenderness	No	36(25.5%)	2(4.7%)	0.002**
	Yes	105(74.5%)	41(95.3%)	
Elevated temperature	No	63(44.7%)	7(16.3%)	0.001*
	Yes	78(55.3%)	36(83.7%)	
Elevated WBC count	No	39(27.7%)	1(2.3%)	0.000**
	yes	102(72.3%)	42(97.7%)	
Left shift of WBC	No	82(58.2%)	10(23.3%)	0.000*
	Yes	59(41.8%)	33(76.7%)	

Extra signs	No	32(22.7%)	7(16.3%)	0.523*
	Yes	109(77.3%)	36(83.7%)	
Operative findings	Normal appendix	6(4.3%)	0(0.0%)	0.000**
	Inflamed appendix	135(95.7%)	0(0.0%)	
	Highly inflamed appendix	0(0.0%)	32(74.4%)	
	Perforated appendix	0(0.0%)	7(16.3%)	
	Gangrenous appendix	0(0.0%)	4(9.3%)	
Modified Alvarado Scoring System	Less than 7	32(22.7%)	2(4.7%)	0.006**
	Equal to /more than 7	109(77.3%)	41(95.3%)	
Histopathology	Normal appendix	2(1.4%)	0(0.0%)	0.006**
	Acute appendicitis	107(75.9%)	30(69.8%)	
	Suppurative / gangrenous appendicitis	11(7.8%)	11(25.6%)	
	Chronic appendicitis	21(14.9%)	2(4.7%)	
*Pearson chi square test.				
**Fischer's exact test.				

Discussion

Early appendectomy is the most appropriate treatment for most cases, however some cases may presented late or the management is delayed for a variety of reasons which result in higher rate of complications. There is a term used in some articles called (irreversible appendicitis), which indicates either gangrenous or perforated appendicitis, indicating that both cases are very difficult to be cured with conservative treatment and need surgical intervention. [1, 5, 8, 9]

Most series the rate of the complicated appendicitis is reported to be between 20-30% of the cases, in our study the rate of complicated appendicitis was 23.37%. Complicated appendicitis is found to be reported in higher age groups, in our study about 82.6% of the patients were below 30 years, and the correlation was not significant between the age and the complicated type (P value 1.00). The majority of our patients were young and middle aged, studies reported that the rate of complications is higher in populations older than 65 years. [7, 10]

The number of females admitted for acute appendicitis were more than number of males, but the percentage of complicated appendicitis outnumbered those for the females by about 9 folds, 93% for males versus 7% for females, with a very significant correlation between complicated appendicitis and the gender (P value 0.000). This may be attributed that the pain threshold in females is less than that of

males, so that males presented late, also female may present because of various problems related to ovaries and oviducts. Some studies proved that gender is not considered as a risk factor for the development of complications.[2, 6]

The duration of symptoms, whether less than 24 or more, had not been attributed to the development of complicated appendicitis in our study (P value 0.807), similarly the frequency of attacks and the number of hospital admissions had no correlations with the complicated appendicitis (P values 0.562 & 0.524) respectively. This findings have been detected in some other related articles proving that late presentation is not a risk factor provided that the symptoms and signs are not severe, some studies suggested that time of referral greater than 12 hours is associated with higher complication rates specially when patients have severe signs and symptoms. Uncomplicated appendicitis usually respond to antibiotics lone during the initial visit, up to 30% of them may report repeated admissions and eventually treated with appendectomy within one year. [3, 6, 11-13]

In correlating the symptoms, the development of complicated appendicitis, anorexia, nausea and vomiting, and the migration of pain from periumbilical region to the right lower quadrant had no significant correlation (P values 0.173, 0.262, and 0.079) respectively, these are the typical symptoms, some authors studied the relation of atypical symptoms to the development of complicated appendicitis such as epigastric pain, lack of anorexia, and diarrhea, such symptoms are not typical for appendicitis and this may mislead the surgeon about the possibility of some other pathologies leading to delay in the diagnosis. [2]

Elevated temperature is an important clinical sign for differentiating complicated from uncomplicated appendicitis, the correlation was significant in our study (P value 0.001). Fever is one of the systemic response to sepsis, the degree of elevation may be correlated to the severity of intraperitoneal sepsis. [5, 14]

Other aspects of the clinical examination are of great importance particularly local signs at the right lower quadrant during abdominal examination. The anatomical position of the appendix is variable, but in most patients the cecum with its attached appendix, is present in the right lower quadrant. The presence of right lower abdominal tenderness and rebound tenderness are the most important signs, eliciting extra signs such as Rovsing's, obturator sign and rectal tenderness, are important to detect appendicitis in retrocecal or pelvic positions of the appendix. In our study tenderness at the right lower quadrant had no significant correlation with the complicated type (P value 1.00) in contrast to rebound tenderness which had a very significant correlation (P value 0.002). [5, 14]

The WBC count and the shift to left of WBC is a very important point for the diagnosis of appendicitis, in our study complicated appendicitis was very significantly correlated with both elevated WBC count and shift to left of WBC (P values 0.000) for each of them. [3, 13, 15]

The Alvarado scoring system is used widely to diagnose acute appendicitis and decrease the rate of negative appendectomies, many modifications had been made on this scoring system in order to

increase the accuracy of clinical diagnosis, the modified Alvarado scoring system add extra clinical signs during examination. Scores more than 7 are labelled as the patients mostly is having acute appendicitis, patients having scores below 7 may be observed or managed conservatively unless some other evidences of appendicitis are present such as typical imaging findings. In our study, we adopt the modified scoring system, most of our patients had a score greater than 7 (81.52%). Complicated appendicitis had a very significant correlation with modified Alvarado scoring system (P values 0.006), but no correlation with extra signs and the (P values 0.523). Clinical scoring systems had been found to be relatively accurate in the diagnosis of appendicitis, however in the presence of atypical symptoms and signs, or in the presence of septic complications, their diagnostic accuracy reduced greatly. [4]

Normal appendix constituted 2% of our cases which was proved by the histopathological examination, however during surgery the reported rate of normal appendicitis was 4.3%, this is because normal looking appendix may be inflamed by microscopic examination. Complicated appendicitis is evident at the time of surgery by the presence of inflammatory mass, free pus, gangrenous appendicitis, and perforated one, this can be easily differentiated from the non-complicated type.

Conclusion

The rate of complicated appendicitis should be reduced to decrease the associated morbidity, the presence of rebound tenderness, fever, high WBC count and sift to left, a score of 7 or more by modified ALVAADO score, and male sex are highly suggestive. The presence of these factors mandates early and prompt intervention.

List Of Abbreviations

CT-scan: computed tomography scan.

RLQ: Right lower quadrant.

WBC: White blood cells.

Declarations

Funding: The authors are the source of funding.

Conflict of Interest: There is no conflict of interest to be declared.

Informed consent: An informed written consent was taken from the patients to be included in this study.

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Figures

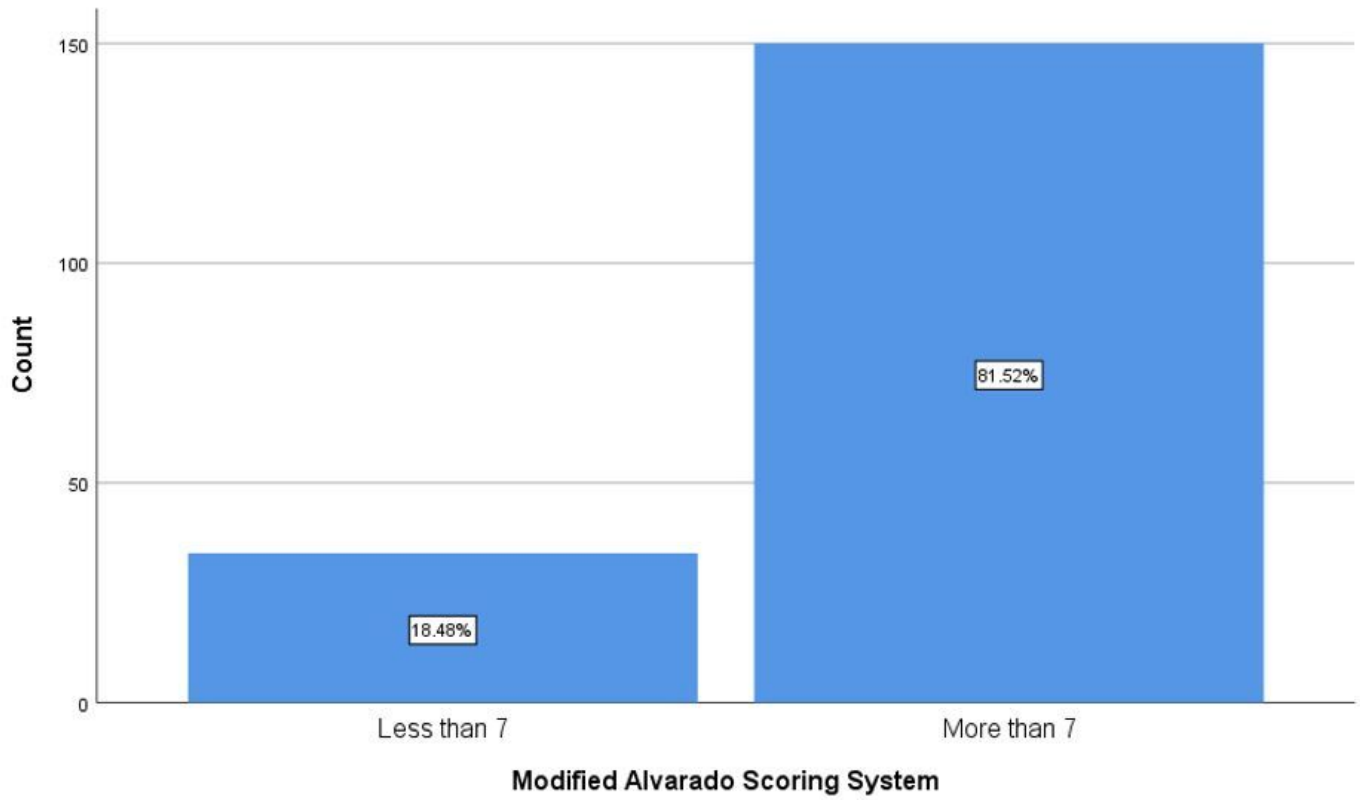


Figure 1

A simple bar chart showing the score of the modified alvarado score, cut value of 7 were considered.

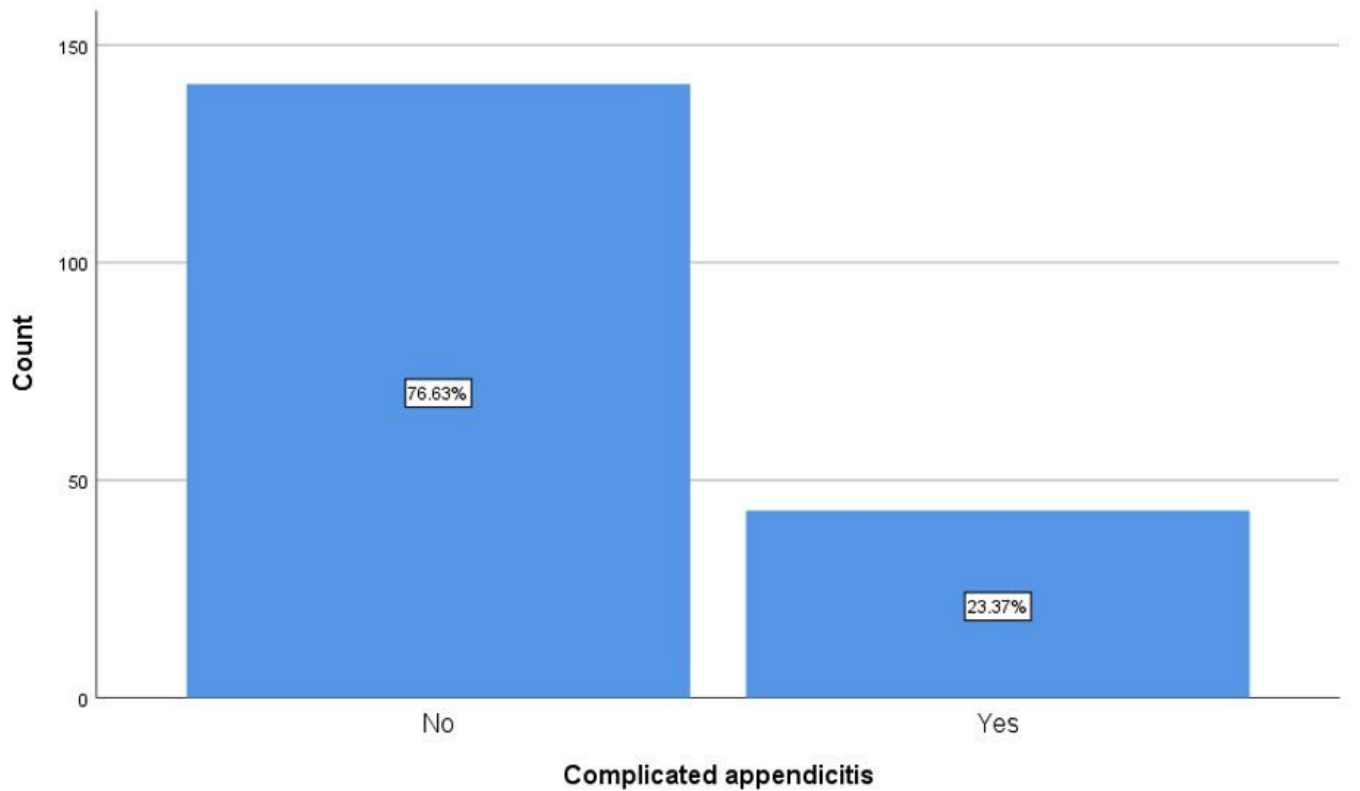


Figure 2

A simple bar chart showing the percentages of each groups of patients, whether complicated or uncomplicated appendicitis.

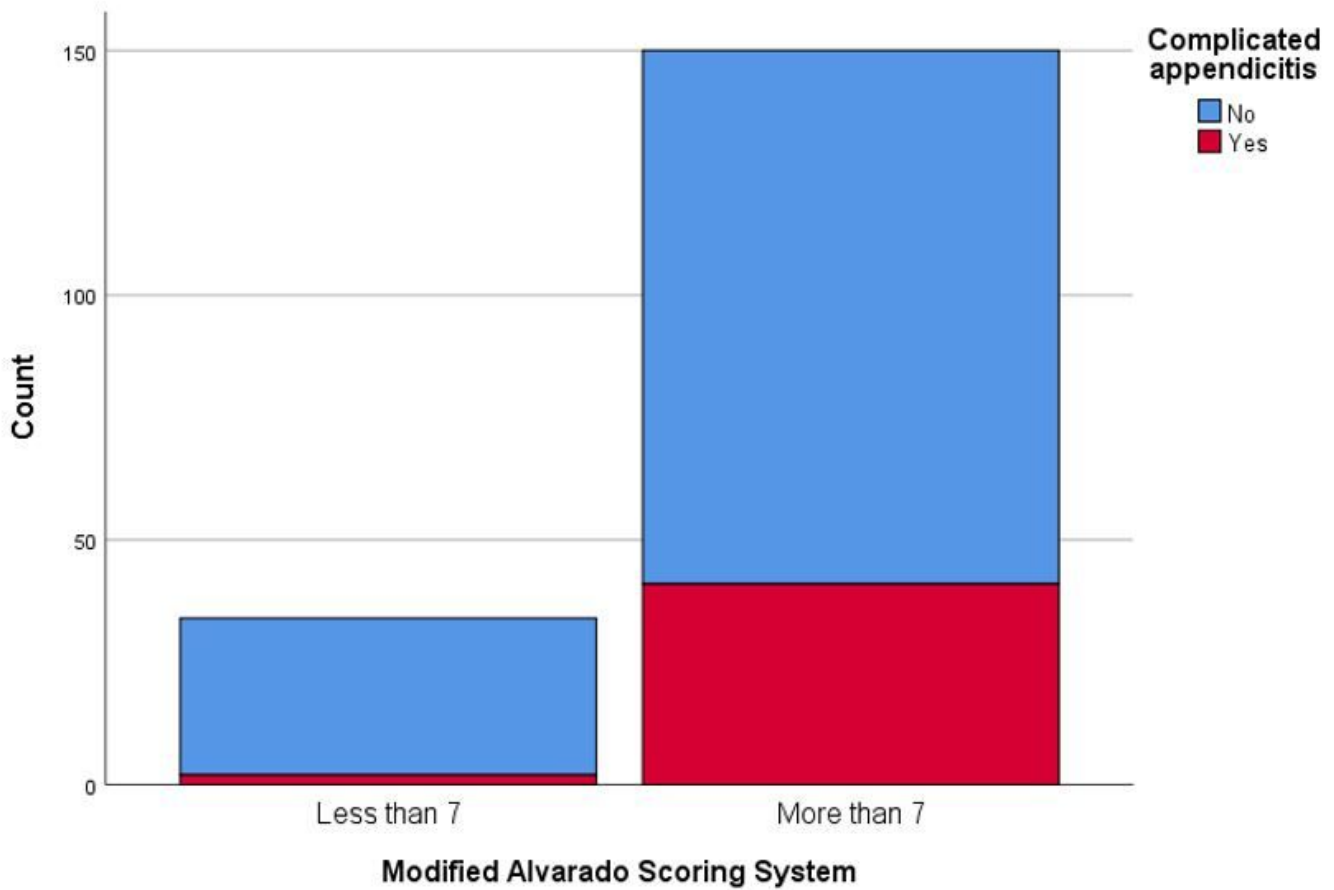


Figure 3

A stacked bar chart showing the relation of the both patient groups and the modified Alvarado score.