Turkish Journal of Trauma & Emergency Surgery
Original Article
Ulus Travma Acil Cerrahi Derg 2011;17 (5):396-400
Klinik Çalışma
doi: 10.5505/tjtes.2011.03780

Scoring systems in the diagnosis of acute appendicitis in the elderly

Yaşlılarda akut apandisit tanısında skorlama sistemleri

Ali KONAN,[1] Mutlu HAYRAN,[2] Yusuf Alper KILIÇ,[1] Derya KARAKOÇ,[1] Volkan KAYNAROĞLU[1]

BACKGROUND
Although special features of acute appendicitis in the elderly have been described in some studies, no studies evaluating the applicability of appendicitis scores exist in the literature. The aim of this study was to compare Alvarado and Lintula scores in patients older than 65 years of age.

METHODS
Patients older than 65 years with appendicitis confirmed by pathology report were matched by year of admission with a group of patients admitted to the emergency department with non-specific abdominal pain. Alvarado and Lintula scores were calculated retrospectively from patient charts.

RESULTS
Both scores were observed to operate well in distinguishing between abdominal pain due to appendicitis and non-specific abdominal pain. The Alvarado score was a better predictor compared to the Lintula score. Two parameters (absent, tingling or high-pitched bowel sounds and nausea) had similar prevalence in the control and appendicitis groups. We selected to recalculate the two scores with the exclusion of these two parameters. The two scores performed better but were more similar to each other after the modification.

CONCLUSION
Both Alvarado and Lintula scores have a high sensitivity and specificity in the diagnosis of acute appendicitis in the geriatric age group. Their performance improves with exclusion of the two parameters "nausea" and "absent, tingling or high-pitched bowel sounds".

Key Words: Acute appendicitis; Alvarado score; elderly; Lintula score.

AMAÇ
Literatürde, yaşlılarda akut apandisitin özellikleri bazı çalışmalarda tarif edilmiştir, ancak skorlama sistemlerinin uygulanabilirliğini değerlendiren bir çalışma yoktur. Bu çalışmanın amacı 65 yaşından yaşlı hastalarda Alvarado ve Lintula skorlarını karşılaştırmaktır.

GEREÇ VE YÖNTEM
Tanısı patolojik inceleme ile kesinleşmiş 65 yaşından yaşlı hastalar, büyük acil polikliniğine başvuruları sonucunda spesifik olmayan karın ağrısı tanısı almış aynı yaş grubundaki hastalarla başvuru yılına göre sınıflandırılarak karşılaştırıldı. Alvarado ve Lintula skorları hasta dosyalarından retrospektif olarak hesaplandı.

BULGULAR
Her iki skorlama metodu da apandisite bağlı karın ağrısı ve spesifik olmayan karın ayrısını ayırt etmede başarılı bulundu. Alvarado skoru, Lintula skoruna göre öngörme özelliği açısından üstündü. Kontrol ve apandisit gruplarında iki parametrenin (tınlayıcı, tiz bağırsak sesleri olması veya bağırsak seslerinin alınamaması ve bulantı) prevalansı benzerdi. İki skor, bu iki parametre olmadan tekrar hesaplandı. Düzenleme sonrası iki skorda daha iyi ve birbirlerine daha çok benzer sonuçlar verdi.

SONUÇ
Geriatrik yaş grubunda hem Alvarado hem de Lintula skorlarının akut apandisitin tanısında yüksek sensitivite ve spesifitesi vardır. Bu skorların performansları "bulantı" ve "tınlayıcı, tiz bağırsak sesleri olması veya bağırsak seslerinin alınamaması" parametreleri çıkartıldığında daha iyi hale gelmektedir.

Anahtar Sözcükler: Akut apandisit; Alvarado skoru; yaşlı; Lintula skoru.

Departments of [1]General Surgery, [2]Preventive Oncology, Hacettepe University Faculty of Medicine, Ankara, Turkey.
Hacettepe Üniversitesi Tıp Fakültesi, [1]Genel Cerrahi Anabilim Dalı, [2]Prevantif Onkoloji Anabilim Dalı, Ankara.

Correspondence *(İletişim):* Ali Konan, M.D. Hacettepe Üniversitesi Tıp Fakültesi Genel Cerrahi Anabilim Dalı, Sıhhıye 06100 Ankara, Turkey.
Tel: +90 - 312 - 305 43 76 e-mail *(e-posta):* akonan@hacettepe.edu.tr

The lifetime risk of acute appendicitis in the general population is 7%, and up to 10% of acute appendicitis occurs in the geriatric population (older than 65 years of age).[1,2] Appendicitis tends to have a more complicated course with advancing age.[3] The increased rate of perforation may be related to late admission of the patients as well as the delay in the diagnosis. Failure to diagnose appendicitis at admission is related to an increased rate of perforation.[4] Numerous diagnostic and clinical scores have been developed to increase the accuracy of diagnosis in acute appendicitis.[5-10] Although special features of acute appendicitis in the elderly have been described in some studies,[11-14] no studies evaluating the applicability of appendicitis scores exist in the literature.

Described in 1986, the Alvarado score is used widely in the diagnosis of acute appendicitis. The score is based on symptoms, physical findings and laboratory data (Table 1). It has been validated in some studies and is found to be reliable, reproducible and cheap in the evaluation of adult patients with right lower quadrant pain.[15]

The Lintula score was originally developed for the pediatric age group,[10] and is shown to offer some benefits compared to unaided clinical diagnosis of acute appendicitis.[16] The score consists of data taken from patient's history and physical examination (Table 2).

The aim of this study was to compare Alvarado and Lintula scores in patients older than 65 years of age.

MATERIALS AND METHODS

Overall, 1728 patients were operated for acute appendicitis. Among these patients, those older than 65 years with appendicitis confirmed by pathology report were identified (n=41). This group of patients was matched by year of admission with a group of patients admitted to the emergency department with non-specific abdominal pain (n=41). Alvarado and Lintula scores were calculated retrospectively from patient charts. The data were analyzed using the Statistical Package for Social Sciences version 15.

RESULTS

There were 18 females and 23 males in the appendicitis group. The median age of patients was 69 (range: 65-83) years. The control group consisted of 23 females and 18 males.

Receiver operating characteristics (ROC) analysis revealed that both scores were observed to operate well in distinguishing between abdominal pain due to appendicitis and non-specific abdominal pain. The Alvarado score was a better predictor (area under the curve [AUC]: 96.9%, 95% confidence interval [CI]: 94.0%-99.8%) when compared to the Lintula score (AUC: 92.8%, 95% CI: 87.4%-98.2%).

Table 3 and Figure 1a show the operative characteristics for several cut-off points for both scores. For the Alvarado score, one can observe that the two cut-off points of 3 and 6 have 100% negative and positive predictive values, respectively, while maintaining an overall accuracy of more than 85%. The two values can be practically used as cut-off points to rule out or definitely diagnose appendicitis. An Alvarado score of less than 3 rules the disease out, while a score of 6 or greater is indicative of appendicitis. For the values in between, further diagnostic evaluation and/or watchful waiting is required.

In this geriatric age group, we observed that the two parameters utilized in the calculation of these scores were not very informative, as they had similar prevalence in the control and appendicitis groups, respectively (33.3% vs. 40.0% for absent, tingling or high- pitched bowel sounds, and 30.8% vs. 29.3% for nausea). Therefore, we selected to recalculate the two scores excluding these two parameters.

Table 3 and Figure 1b show the results of the analyses with modified scores. The AUC values improved to 97.5% (95% CI: 95.0%-100.0%) for Alvarado and 95.1% (95% CI: 90.5%-99.6) for Lintula scores. The two scores performed better but were more similar to each other after the modification. Now, it could easily be observed that Lintula scores performed closer to Alvarado scores, as both of the relatively ineffective

Table 1. Alvarado scoring system

Parameter	Score
Abdominal pain	1
Anorexia	1
Nausea and/or vomiting	1
Muscular guarding in the right lower quadrant	2
Temperature >37.3°C	1
Rebound tenderness referred to right lower quadrant	1
WBC >10000	1
Left shift of polymorphonuclear WBC forms >75%	1

Table 2. Lintula score

Parameter	Score
Male gender	2
Severe pain	2
Relocation of pain	4
Vomiting	2
Pain in the right lower quadrant	4
Fever (>37.5°C)	3
Guarding	4
Absent, tingling or high-pitched bowel sounds	4
Rebound tenderness	7

Table 3. Operative characteristics of several cut-off points for the Alvarado and Lintula scores

Score	Cut-off point*	Sensitivity	Specificity	PPV	NPV	Accuracy
Alvarado	3	100.0	74.4	80.4	100.0	87.5
	4	92.7	82.1	84.5	91.5	87.5
	5	87.8	89.7	90.0	87.5	88.7
	6	80.5	94.9	94.3	82.2	87.5
	7	70.7	100.0	100.0	76.5	85.0
Lintula	3	100.0	33.3	61.2	100.0	67.5
	7	95.1	66.7	75.0	92.8	81.3
	9	87.8	74.4	78.3	85.3	81.3
	10	87.8	76.9	80.0	85.7	82.5
	11	87.8	84.6	85.7	86.8	86.2
	12	87.8	87.2	87.8	87.2	87.5
	13	85.4	87.2	87.5	85.0	86.3
	14	82.9	89.7	89.4	83.3	86.2
	15	75.6	89.7	88.5	77.8	82.5
	16	73.2	89.7	88.2	76.1	81.2
	17	70.7	92.3	90.6	75.0	81.2
	21	58.5	100.0	100.0	69.6	78.7
Alvarado (Modified)	3	100.0	79.5	83.7	100.0	90.0
	4	90.2	82.1	84.1	88.9	86.3
	5	87.8	94.9	94.7	88.1	91.3
	6	75.6	100.0	100.0	79.6	87.5
Lintula (Modified)	1	100.0	17.9	56.2	100.0	60.0
	7	92.7	82.1	84.4	91.4	87.5
	8	92.7	87.2	88.4	91.9	90.0
	10	87.8	87.2	87.8	87.2	87.5
	12	87.8	89.7	90.0	87.5	88.8
	13	82.9	94.9	94.4	84.1	88.8
	15	73.2	94.9	93.8	77.1	83.8
	19	58.5	100.0	100.0	69.6	78.8

The modified scores exclude the scores related to the "nausea" and "absent, tingling or high-pitched bowel sounds" parameters.
* Cut-off is included in positive classification; PPV: Positive predictive value; NPV: Negative predictive value.

parameters (i.e. change in bowel sounds and nausea) are included in the original scoring of Lintula (multiplied by coefficients of 4 and 2), while only the nausea parameter is used in the original scoring of Alvarado. Alvarado scores still have two distinct cut-off points but with better predictive characteristics after the modification, which can be used to rule out (<3) or definitely diagnose (≥6) appendicitis.

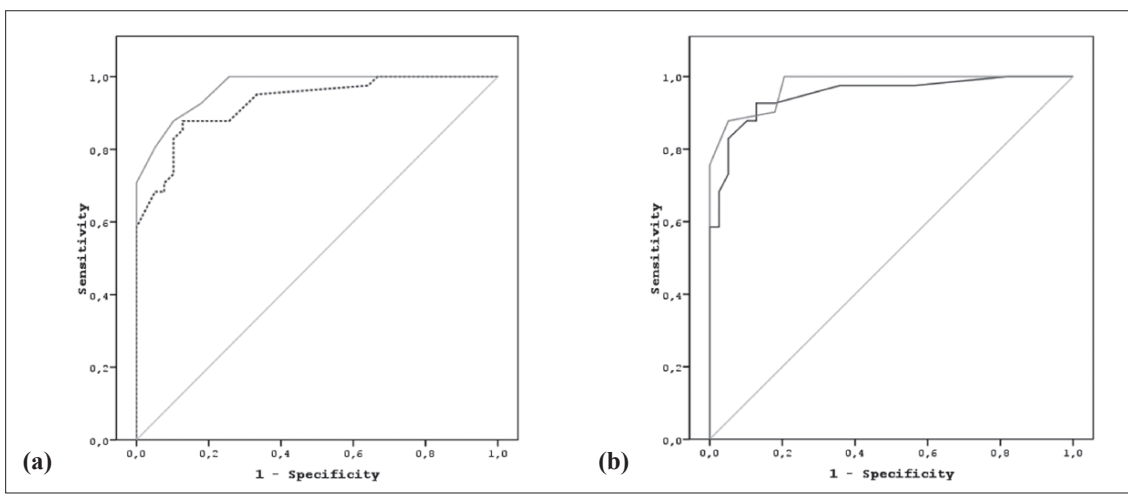


Fig. 1. Receiver Operating Characteristics (ROC) curve showing the predictive values for the Alvarado (solid line) and Lintula (dashed line) scores (a) with and (b) without the modified parameters.

DISCUSSION

Nearly half of the patients older than 65 years who present to the emergency department have abdominal pain,[17] and acute appendicitis is the third most common cause of acute abdomen in the elderly after intestinal obstruction and biliary disease.[18] The course of acute appendicitis is relatively unfavorable in geriatric patients, and perforated appendicitis rates are higher than in younger patients. This increase in rate may be related to late presentation of the patients as well as to delay in the diagnosis. In the geriatric population, acute appendicitis is misdiagnosed in about half of the patients, and one-fourth of the patients require more than 24 hours to be diagnosed as acute appendicitis.[4]

To increase the diagnostic accuracy in acute appendicitis, several scores have been developed. Although most of these scores are validated in the adult population, no study exists in the literature evaluating the geriatric population. The diagnosis of acute appendicitis in the geriatric population is challenging. The classical symptoms of acute appendicitis are defined as fever, right lower quadrant pain, anorexia, and white blood cell count >10000/mm^3. In the geriatric population, less than one-third of the patients present with all four symptoms.[4] The data about specific symptoms of acute appendicitis have a wide range. For example, fever was reported to occur in 37% of the patients in one series[4] and 71% in another.[19] Similarly, the right lower quadrant pain is reported to occur in 64-91% of the patients. These variations in the reported incidence may be due to physiological changes in the structure of the appendix vermiformis with aging.

In our study, we compared Alvarado and Lintula scores in a geriatric group. The appendicitis group consisted of patients with histopathologically confirmed appendicitis, and the control group was formed of patients who were admitted to the emergency department with abdominal pain and diagnosed as nonspecific abdominal pain, since no pathology was found on clinical investigations and their pain subsided under clinical observation. As the course of acute appendicitis is often atypical in the geriatric population, comparison of these two groups to detect the efficacy of Alvarado and Lintula scores is appropriate.

The Alvarado score is widely used in the diagnosis of acute appendicitis. The score is calculated over 10 points, and a score higher than 6 is indicative of acute appendicitis, whereas for scores less than 4, it is unlikely that the patient has appendicitis. For scores of 4-6, follow up or imaging with computerized tomography is recommended.[20] Chan et al.,[21] in their series of 175 patients with a mean age of 30, reported the negative cut-off point to be 5.

The analysis of the data gave us two cut-off points for the Alvarado score. None of the patients with acute appendicitis had an Alvarado score below 3, and all the patients with a score above 7 had appendicitis. This finding is compatible with that of McKay et al.[22] They found a 96.2% sensitivity and 67% specificity for scores of 3 or lower for not having appendicitis and 77% sensitivity and 100% specificity for scores of 7 or higher for having appendicitis. These findings suggest that the Alvarado score may be used in the geriatric population.

The Lintula score was first developed for the pediatric age group.[10] Later, the same group validated the Lintula score in the adult population as well. They showed that the use of the Lintula score yielded a higher positive predictive value and specificity but a lower negative predictive value and sensitivity in the diagnosis of appendicitis compared with unaided diagnosis. They determined cut-off points of 15 and 21 to rule-out and diagnose appendicitis, respectively.[16] In our series, the positive predictive value for a score of 21 was 100%, with an accuracy of 78%. The cut-off limit of 15 had a positive predictive value of 88.5% and a negative predictive value of 77.8%. We found the optimal cut-off point to be 12 points, with a positive predictive value of 87.2% and a negative predictive value of 87.8%.

In this geriatric group, two parameters used in the scores, i.e., "absent, tingling or high-pitched bowel sounds" and "nausea", had similar prevalence in both the appendicitis and control groups. This finding may be related to age-related changes seen in the gastrointestinal tract. As the number and function of the myenteric enteric nervous system decrease with age, there is a decrease in the motility of the gastrointestinal system, and constipation is seen in one-fourth of the individuals over 65 years of age.[23] Therefore, these two parameters may also be found in elderly individuals without an intraabdominal pathology.

The "absent, tingling or high-pitched bowel sounds" parameter has a coefficient of 4 and "nausea" has a coefficient of 2 in the original Lintula score, while nausea adds one point to the Alvarado score. After omitting these parameters, the modified Lintula score has a maximum of 26 and the modified Alvarado has a maximum of 9. With these modifications, both scores performed better (improvements in AUC from 96.9% to 97.5% and 92.8% to 95.1% for Alvarado and Lintula scores, respectively) and were closer to each other. The cut-off values for the modified Alvarado score are 3 and 6, and for Lintula score the optimal cut-off is 8. Although these data need to be validated with prospective trials, the use of these modified scores may be advisable.

To diagnose appendicitis, clinicians should take into account all available historical and physical find-

ings as well as laboratory and imaging data. There is no pathognomonic sign, symptom or laboratory test for appendicitis. Radiologic imaging studies have a high sensitivity and specificity, but routine use of these techniques not only increases the cost but is also associated with radiation and contrast exposure. Although the data presented in this study need to be validated with prospective trials, the use of these modified scores may be advisable.

In conclusion, both Alvarado and Lintula scores have a high sensitivity and specificity in the diagnosis of acute appendicitis in the geriatric age group. Their performance improves with exclusion of the "nausea" and "absent, tingling or high-pitched bowel sounds" parameters.

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