Comparison between AIR, Alvarado and RIPASA scores in the diagnosis of acute appendicitis in a Western population.

A retrospective cohort study

Ann. Ital. Chir., 2022 93, 4: 427-434
pii: S0003469X22036533

Gaetano Poillucci*, Mauro Podda**, Dario Oricchio*, Kevin Levy Medina*, Gabriele Manetti***, Renato De Angelis***

**Department of General and Specialized Surgery "Paride Stefanini", Policlinico Universitario Umberto I, Rome, Italy*
***Department of Emergency Surgery, Azienda Ospedaliero-Universitaria di Cagliari, Policlinico Universitario "D. Casula", University of Cagliari, Monserrato, Italy*
****Department of General Surgery, San Giovanni Addolorata Hospital, Rome, Italy*

Comparison between AIR, Alvarado and RIPASA scores in the diagnosis of acute appendicitis in a Western population. A retrospective cohort study.

AIM: *The aim of this retrospective study is to evaluate raja isteri pengiran anak saleha appendicitis (RIPASA) score in the italian population with histopathologic diagnosis of acute appendicitis (AA) compared to appendicitis response inflammatory (AIR) and Alvarado scores.*
MATERIAL AND METHODS: *Included were patients who had undergone appendectomy for AA from 01/01/2017 to 31/12/2019 in the General and Emergency Surgery of the San Giovanni Addolorata Hospital (Rome, Italy) in whome it was possible to calculate AIR, Alvarado and RIPASA scores at admission.*
RESULTS: *We retrospectively analyzed 369 patients; a total of 320 patients (86.7%) were histologically confirmed. At a cut-off ≥7.5, the RIPASA score showed a sensitivity of 90.9%, a specificity of 63.3%, a positive predictive value (PPV) of 94.2%, a negative predictive value (NPV) of 51.7% and a diagnostic accuracy of 87.3%; the area under curve values for RIPASA was greater than that of AIR and Alvarado scores (0.851 vs 0.796 vs 0.766, respectively).*
DISCUSSION: *The pre-operative diagnosis of AA is often a challenge for the surgeon. To reduce negative appendectomies, many preoperative diagnostic scores have been designed: the RIPASA score has shown better sensitivity and specificity in asian and middle-eastern populations better sensitivity and specificity.*
CONCLUSIONS: *The RIPASA score is a useful tool to aid in the diagnosis of AA in the Italian population. At a value of ≥7.5, RIPASA demonstrated a high-sensitivity, a PPV and diagnostic accuracy in our cohort and was more accurate than AIR and Alvarado scores.*

KEY WORDS: AIR score, Alvarado score, RIPASA score

Introduction

Acute Appendicitis (AA) is among the most common causes of lower abdominal pain and one of the most common surgical emergencies, with a lifetime prevalence of approximately 8% [1].

AA occurs at a rate of 5.7-50 patients per 100,000 inhabitants per year [2,3]. The lifetime risk of developing AA is 8.6% for males and 6.7% for females. However, the risk of undergoing appendectomy is much lower for males than for females (12% vs 23%) and is highest between the ages of 10 and 30 [4].
Despite being a common problem, AA remains a difficult diagnosis to establish, particularly among the elderly and females of reproductive age, where a host of other genitourinary and gynecological inflammatory conditions may present with signs and symptoms similar to those of AA [5]. Approximately one-third of AA cases present with atypical clinical symptoms [6].

Pervenuto in Redazione Maggio 2021. Accettato per la pubblicazione Luglio 2021
Correspondence to: Gaetano Poillucci, MD, Department of General and Specialized Surgery "Paride Stefanini", Policlinico Universitario Umberto I, Rome, Italy, Viale del Policlinico 155, 00161 Rome, Italy (e-mail: gaetano.poillucci@gmail.com)

The diagnostic workup can be improved by using clinical scoring systems that involve physical examination findings and inflammatory markers. Many user-friendly and straightforward scoring systems have been used as a structured algorithm to aid in predicting the risk of AA and decreasing negative appendectomy. Still, none has been widely accepted [7,8].

The role of diagnostic imaging, such as ultra sound (US), computed tomography (CT), and magnetic resonance imaging (MRI), is another major controversy [9-10]. US is limited in obese patients, those with severe abdominal pain, and retrocaecal and perforated appendices [11]. CT and MRI are relatively expensive and not readily available in all centers. The most used clinical scores in Italy and western countries are the appendicitis response inflammatory (AIR) score and the Alvarado score. The raja isteri pengiran anak saleha appendicitis (RIPASA) score is a new diagnostic scoring system developed for diagnosis of AA. The RIPASA score has been shown to have high sensitivity, specificity, and diagnostic accuracy, mainly when applied to the Asian and middle eastern populations [12,13]. This study evaluates the RIPASA score compared to the AIR and to Alvarado scores in the Italian population in terms of sensitivity, specificity, positive predictive value, and diagnostic accuracy.

Material and Methods

The study included all patients above 18 years of age who underwent appendectomy for suspect AA, referred to the San Giovanni Addolorata Hospital (Rome, Italy) during the period january 2017 to december 2019.

Exclusion criteria were: pregnant or lactating women, non-consenting patients, patients who had undergone appendectomy during other abdominal surgical procedures, patients who had undergone elective appendectomy and those with incomplete data.

Informed consent for the treatment of personal and sensitive data was obtained from all participants included in the study, and all procedures were in accordance with the ethical standards of the institutional and national research committee and the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The report of this study was prepared following the STROBE (strengthening the reporting of observational studies in epidemiology) statement for observational studies [14].

Data Gathering

The following data were recorded for all subjects: complaints at the time of admission, examination and laboratory findings. The data obtained were used to calculate AIR, Alvarado and RIPASA scores. All patients underwent an appendectomy and were categorized into two groups, positive appendectomy and negative appendectomy based on the histopathologic diagnosis.

Evaluated Scores

The AIR score contains seven parameters, including clinical examination, white blood cell (WBC) count, and C-reactive protein (CRP), while the Alvarado score includes eight parameters such as clinical examination and WBC count. The RIPASA score includes eighteen metrics related to clinical examination, WBC count, and urine analysis. The values for each of the components range from 1 to 3 for the AIR score, 1 to 2 for the Alvarado score and 0.5 to 2 for the RIPASA score (Tables I, II, III).

Table I - *AIR scoring system.*

Symptoms	Score
RIF pain	1
Vomiting	1
Signs	
TC > 38.5°C	1
Abdominal defense	
Low	1
Mild	2
Severe	3
Laboratory tests	
Polymorphonuclear leucocytes	
70% - 84%	1
≥ 85% 2	
WBC count	
10.0 - 14.9 x 10^9/l	1
≥15.0 x 10^9/l	2
CRP concentration	
10 - 49 mg/l	1
≥ 50 mg/l	2

AIR score: sum 0-4 = low probability, sum 5-8 = indeterminate group, sum 9-12 = high probability

Table II - *Alvarado scoring system.*

Symptoms	Score
Pain migration to RIF	1
Anorexia	1
Nausea or vomiting	1
Signs	
Rebound tenderness	1
RIF tenderness	2
Fever	1
Laboratory tests	
Polymorphonuclear leucocytes > 75%	1
WBC count > 10.0 x 10^9/l	2

Alvarado score: sum 0-4 = low probability, sum 5-6 = indeterminate group, sum 7-10 = high probability

TABLE III - *RIPASA scoring system.*

Patient's demographic	Score
Male	1
Female	0.5
Age < 39.9 years	1
Age > 40 years	0.5
Symptoms Score	
RIF pain	0.5
Pain migration to RIF	0.5
Anorexia	1
Nausea and vomiting	1
Duration of symptoms < 48 hours	1
Duration of symptoms > 48 hours	0.5
Signs	
RIF tenderness	1
RIF guarding	2
Rebound tenderness	1
Rovsing's sign	2
TC > 37° C, < 39° C	1
Investigations	
Raised WBC count	1
Negative urinalysis	1

RIPASA score: sum < 5 = AA very unlikely; sum 5-7.0 = AA unlikely; sum 7.5-11.0 = AA very likely; sum = definitely AA

The attending surgeon compiled scoring charts at the time of admission. A score of 9 or more for the AIR scoring system, a score of 7 or more for the Alvarado score and a score of 7.5 or more for the RIPASA scoring system was considered a high probability of AA. The decision on appendectomy was solely based solely on the surgeon's clinical judgment after considering all findings of the clinical examination and laboratory tests. The AIR, Alvarado and RIPASA scores were calculated only for the study purpose. Histopathology findings of operated cases were collected and correlated with both the counts.

STATISTICAL ANALYSIS

The data were analyzed using SPSS windows version 20. Descriptive statistics for categorical variables were expressed as numbers and percentages, while the mean ± standard deviation (SD) was used to represent continuous variables based on the normal distribution. Student's t-test was used for variables with normal distribution, while the mann-whitney U test was used for variables without normal distribution. The screening performance characteristics of the scoring systems were evaluated. A larger area under the receiver operating characteristic (ROC) curve indicated better diagnostic value. A p-value <0.05 was considered statistically significant.

Results

A total of 369 patients with AA were enrolled in this retrospective study. As shown in (Table IV), 213 patients (57.7%) were male, and 156 (42.3%) were female. The mean age of the cohort was 38.7 ± 16.0 years.

The distribution of the most common clinical parameters is listed in (Table IV).

Histopathological findings included uncomplicated AA in 287 patients (77.8%), perforated appendicitis in 17 patients (4.6%), and lymphoid hyperplasia in 16 patients (4.5%). The negative appendectomy rate was 13.3% (n=49).

The AIR score with a cut-off set at > 8 was determined with a sensitivity of 19.7%, a specificity of 95.9%, a positive predictive value (PPV) of 96.9 %, a negative predictive value (NPV) of 15.5%, and a diagnostic accuracy of 29.8%. With a cut-off set at ≥ 5, the AIR score increased its sensitivity to 88.8%, decreased specificity to 67.3%, with a PPV of 94.7 %, and NPV of 47.8%, and diagnostic accuracy of 85.9%. The Alvarado score with a cut-off set at > 6 performed with a sensitivity of

TABLE IV - *General characteristics of patients enrolled in the study*

N. of patients enrolled in the study	369
Age: Mean ± SD	38.7 ± 16.0
Gender: N. (%)	
Male	213 (57.7%)
Female	156 (42.3%)
Histology for acute appendicitis: N. (%)	
Positive	320 (86.7%)
Negative	49 (13.3%)
Histopathological findings: N. (%)	
AA	287 (77.8)
Perforated appendicitis	17 (4.6%)
Lymphoid hyperplasia	16 (4.5%)
Appendix vermiformis	37 (10%)
IBD	8 (2.1%)
Cancer	4 (1%)
Clinical findings: N. (%)	
RIF pain	340 (92.1%)
Pain migration to RIF	87 (23.6%)
Anorexia	74 (20.1%)
RIF tenderness	283 (76.7%)
Rebound tenderness	39 (10.6%)
Fever	171 (46.3%)
Nausea - Vomiting	145 (39.3%)
Rovsing's sign	131 (35.5%)
Duration of symptoms: N. (%)	
< 48 h	255 (69.1%)
> 48 h	114 (30.9%)
Laboratory findings: Mean ± SD	
WBC count (x 10^9/l)	15.05 ± 4.46
Neutrophils (%)	78.4 ± 5.12
CRP (mg/l)	73.5 ± 113.4
Scores: Mean ± SD	
AIR score	6.3 ± 2.2
Alvarado score	5.4 ± 1.7
RIPASA score	8.9 ± 1.8

Table V - *Comparing the baseline characteristics as well as AA scores between cases with positive and negative appendectomy findings*

	Positive appendectomy (n=320)	Negative appendectomy (n=49)	p-value
Gender (M:F)	186 : 134	27 : 22	0.689965
Age (years ± SD)	40.0 ± 15.9	30.0 ± 13.4	0.000036
RIF pain (Yes : No)	297 : 23	43 : 6	0.220534
Pain migration to RIF (Yes : No)	72 : 248	15 : 34	0.212843
Anorexia (Yes : No)	64 : 256	10 : 39	0.94702
RIF tenderness (Yes : No)	258 : 62	25 : 24	< 0.0001
Rebound tenderness (Yes : No)	36 : 284	3 : 46	0.276951
Fever (Yes : No)	151 : 169	20 : 29	0.40492
Nausea - Vomiting (Yes : No)	126 : 194	19 : 30	0.936227
Rovsing's sign (Yes : No)	115 : 205	16 : 33	0.654566
WBC count (x 109/l)	16.24 ± 6.28	11.05 ± 3.69	< 0.0001
Neutrophils (%)	83.5 ± 7.1	72.9 ± 5.9	< 0.0001
CRP (mg/l)	83.1 ± 122.5	60.6 ± 68.6	0.2103

Table VI - *Screening performance characteristics of different scoring systems in prediction of AA in emergency department*

AIR score	AA detected on histology (n)	AA not detected on histology (n)	Total (n)
AIR > 8	True positive 63	False positive 2	65
AIR ≤ 8	False negative 257	True negative 47	304
Total (n)	320	49	369
AIR ≥ 5	True positive 284	False positive 16	300
AIR < 5	False negative 36	True negative 33	69
Total (n)	320	49	369
Alvarado score			
Alvarado > 6	True positive 94	False positive 5	99
Alvarado ≤ 6	False negative 226	True negative 44	270
Total (n)	320	49	369
Alvarado ≥ 5	True positive 254	False positive 13	267
Alvarado < 5	False negative 66	True negative 36	102
Total (n)	320	49	369
RIPASA score			
RIPASA ≥ 7.5	True positive 291	False positive 18	309
RIPASA < 7.5	False negative 29	True negative 31	60
Total (n)	320	49	369

AIR score > 8 (sensivity 19.7%; specificity 95.9%; PPV 96.9 %; NPV 15.5%; diagnostic accuracy 29.8%)
AIR score ≥ 5 (sensitivity 88.8%; specificity 67.3%; PPV 94.7%; NPV 47.8%; diagnostic accuracy 85.9%)
Alvarado score > 6 (sensivity 29.4%; specificity 89.8%; PPV 95%; NPV 16.3%; diagnostic accuracy 37.4%)
Alvarado score ≥ 5 (sensivity 79.4%; specificity 73.5%; PPV 95.1 %; NPV 35.3%; diagnostic accuracy 78.6%)
RIPASA score ≥ 7.5 (sensitivity 90.9%; specificity 63.3%; PPV 94.2%; NPV 51.7%; diagnostic accuracy 87.3%)

29.4%, a specificity of 89.8%, a positive predictive value (PPV) of 95%, a negative predictive value (NPV) of 16.3%, and a diagnostic accuracy of 37.4%. With a cut-off set at ≥5, the Alvarado score increased its sensitivity to 79.4%, decreased specificity to 73.5%, with a PPV of 95.1%, and NPV of 35.3%, and diagnostic accuracy of 78.6%.

At the optimal cut-off threshold of ≥ 7.5, the sensitivity and specificity of the RIPASA scoring system were 90.9% and 63.3%, respectively. Our study showed a PPV of 94.2%, an NPV of 51.7%, and a diagnostic accuracy of 87.3% for the RIPASA score (Table VI).

The mean age of patients with histologically confirmed AA was 40.0±15.9 vs 30.0±13.4 years in patients without AA (p-value < 0.0001). A statistically significant difference was reported for WBC count between the positive and negative appendectomy groups (16.24±6.28 vs 11.05±3.69, p-value < 0.0001). Similarly, a high percentage of neutrophils (83.5±7.1 vs 72.9±5.9, p-value < 0.0001) was strongly related with positive appendectomy (Table V).

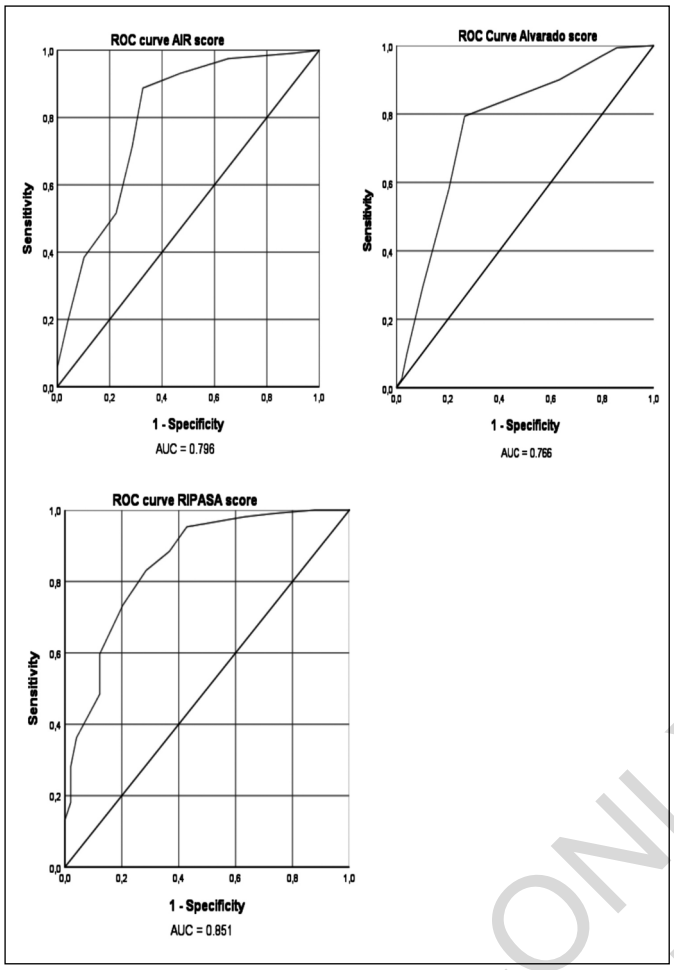

Fig. 1: ROC curves for AIR, Alvarado and RIPASA scoring systems.

Using ROC, the area under curve (AUC) was 0.851 for the RIPASA score, which was higher than that for the AIR score (0.796) and Alvarado score (0.766) as shown in (Fig. 1). The difference in the AUC of 5.5% between RIPASA and AIR scores equated to 20 patients with AA who were misdiagnosed using these two scoring systems. Instead, the difference in the AUC between RIPASA and Alvarado scores was 8.5% equated to 31 patients with AA who were misdiagnosed using these two scoring systems.

Discussion

Geographical differences are reported in the incidence of AA, with a lifetime risk of 9% in the USA, 8% in Europe, and 2% in Africa [15].

There is considerable variation in the presentation, severity of the disease, radiological workup, and surgical management of patients having AA, which is related to country income [16].

Risk stratification of patients with suspected AA by clinical scoring systems can guide decision-making to reduce hospital admissions, optimize the utility of diagnostic imaging, and prevent negative surgical explorations.

Current guidelines recommend the routine use of a combination of clinical parameters and US to improve diagnostic sensitivity, specificity and reduce the need for CT scans in the diagnosis of AA. The use of imaging diagnostics is recommended in patients with intermediate risk of AA after an initial assessment and risk stratification using clinical scores. Conversely, for high-risk patients younger than 40, cross-sectional imaging (ie, CT scan) may be avoided before laparoscopy [17].

Radiological tools used to aid in AA diagnosis, including US, CT, and MRI, have cost implications, require expertise, and are not available out of hours in most institutions [18]. US has a high sensitivity (55-98%) and specificity (78-100%) for AA when the appendix is visualized [19]. Zosimas et al in their retrospective study reported a specificity of 87% and a sensitivity of 34%, confirming that US seems useful to confirm the diagnosis of AA rather than to exclude it [20]. Another retrospective study by Altomare et al concluded that US must be considered the first level instrumental examination, necessary and sufficient in low risk patients to exclude, with a high reliability rate, the diagnosis of AA [21].

In comparison, CT demonstrates high sensitivity (up to 100%) and specificity (95%) and can decrease the negative appendectomy rate to as low as 3% [22].

For this reason, a conditional strategy with CT only after negative or inconclusive US has been suggesting by some authors as the most cost-effective strategy to reduce both the negative appendectomy rate and increase test sensitivity [23].

In our study, the negative appendectomy rate was high compared with those reported in most European countries [24]. This may be explainable by the fact that patients in our study underwent abdominal surgery through the use of a clinical score, and the decision to operate or not was based solely on the surgeon's clinical judgment after taking into consideration all findings of clinical examination and laboratory tests.

The diagnosis of AA is limited mainly when CT scan or US findings are equivocal, since the incidence of equivocal CT findings of AA ranges between 5.0% and 13.1%. AA occurs in up to 30% of patients whose CT is considered inconclusive [25]. Therefore, patient selection solely based on preoperative imaging might not be accurate enough.

Current evidence shows laparoscopic appendectomy to be the most effective surgical treatment for patients with AA, being associated with a lower incidence of wound infection and post-intervention morbidity, shorter hospital stay, and better quality of life scores compared to open appendectomy [26-27]. Several clinical scoring systems have been reported to prevent negative surgical explorations and stratify the risk of patients with suspected AA. Clinical scores alone appear sufficiently sensitive to identify low-risk patients and decrease the need for imag-

ing and negative surgical explorations in patients with suspected AA. We assume that if the decision to operate had been based on clinical scores, the rate of negative appendicitis would have dropped <5%, as reported by other authors [28].

The Alvarado and modified Alvarado scores are most popular for the Western population. The reported sensitivity and specificity of the two scores are 53-88% and 75-80%, respectively [8,29].

Although the Alvarado score is not sufficiently specific in diagnosing AA, a cut-off score of < 5 is sensitive enough to exclude AA (sensitivity of 99%).

In a large retrospective cohort study, Coleman et al found that 100% of males with an Alvarado score of 9 or higher, and 100% of females with an Alvarado score of 10 had AA confirmed by surgical pathology. Conversely, 5% or fewer female patients with an Alvarado score of 2 or less and 0% of male patients with an Alvarado score of 1 or less were diagnosed with AA at surgery [30].

The randomized controlled trial by Andersson et al demonstrated that in low-risk patients the use of an AIR score-based algorithm resulted in less imaging (19.2% vs 34.5%, p-value < 0.001), fewer admissions (29.5% vs 42.8%, p-value < 0.001), fewer negative explorations (1.6% vs 3.2%, p-value = 0.030), and fewer surgical operations for non-perforated AA (6.8% vs 9.7%, p-value = 0.034). Intermediate-risk patients randomized to the imaging and observation strategies had the same proportion of negative appendectomies (6.4% vs 6.7%), number of hospital admissions, rates of perforation, and length of hospital stay, but routine imaging was associated with an increased proportion of patients treated for AA (53.4% vs 46.3%, p-value = 0.020) [31].

Kularatna et al showed that the overall best performer in terms of sensitivity (92%) and specificity (63%) was the AIR score [32].

In 2010, in a retrospective analysis of 312 patients the RIPASA score was reported as a new scoring system based on patients' demographics, the presenting symptoms, clinical signs and laboratory investigations [12].

The minimum and maximum total scores achievable with this new appendicitis scoring system were 2 and 16, respectively. The sensitivity and specificity achieved were 88% and 67%, respectively, with a diagnostic accuracy of 81%, while the PPV and NPV for this score were 93% and 53%, respectively. In the study by Chong et al [12], the predicted negative appendectomy rate was 6.9%, accounting for a 9.4% reduction from the raw data, and higher statistical significance (p-value = 0.0007).

The RIPASA score has been shown to achieve higher sensitivity and specificity than the Alvarado score in Asian and middle eastern populations. Frountzas et al studied 2161 cases of AA and found that the RIPASA scoring system was more sensitive, but had lower specificity than the Alvarado system [33]. Chong et al found that the RIPASA score had 97.5% sensitivity, 81.8% specificity, and 91.8% diagnostic accuracy [34]. In another study by Butt et al, the RIPASA score had a sensitivity of 96.7%, specificity 93.0%, and its diagnostic accuracy was 95.1% [35].

In our study, the sensitivity of the RIPASA score was 90.9%, had a specificity of 63.3%, a PPV of 94.2%, an NPV of 51.7%, and a diagnostic accuracy of 87.3%. Our results demonstrate that this scoring system has a high sensitivity, PPV, and diagnostic accuracy in the Italian population at a cut-off value of 7.5, as also reported by Chong et al [12].

In our study, the RIPASA score had a sensitivity comparable with that reported by Khalil et al and Chong et al in their retrospective studies (both with a sensitivity of 88%, specificity of 67% and diagnostic accuracy of 81%) [12,36], although not as accurate as that in the prospective studies by Nanjundaiah et al and Chong and et al (sensitivity > 95% and specificity > 80%) [37].

Malik et al recently published the first study evaluating the utility of the RIPASA score in predicting AA in a Western population. The results of their study are similar to ours: the RIPASA score demonstrated reasonable sensitivity (85.39%), specificity (69.86%), PPV (84.06%), NPV (72.86%), and diagnostic accuracy (80%) in a cohort of Irish patients with suspected AA [38].

This study presents some limitations, namely its retrospective design, relatively small sample size, and different physicians deciding for appendectomy in different cases.

Further prospective studies with larger sample sizes are required to support our findings and validate the RIPASA scoring system also in the Western population.

Conclusion

The RIPASA score is a user-friendly, rapid, and non-invasive diagnostic tool for the diagnosis of AA. It has shown excellent sensitivity, PPV, and diagnostic accuracy in a cohort of Italian patients with AA. Our study demonstrated a similar score's sensitivity to that shown in the Eastern population. Using this score, it is possible to reduce the negative appendectomy rate and the use of diagnostic imaging.

Acknowledgements

The authors thank Dr David C Nilson, Ph D, for revising the English.

Riassunto

L'appendicite acuta è tra le cause più comuni di dolore addominale ai quadranti inferiori e una delle urgenze chirurgiche maggiormente diffuse. Il rischio di svi-

luppare un episodio di appendicite acuta nel corso della vita è pari all'8.6% nei maschi e al 6.7% nelle femmine. Tuttavia, la necessità di sottoporsi ad appendicectomia è molto più bassa nei maschi rispetto alle femmine (12% contro 23%, rispettivamente) con una maggiore frequenza nell'età compresa tra i 10 e i 30 anni.
Nonostante sia una urgenza comune, la diagnosi di appendicite acuta risulta non sempre di semplice formulazione, in particolare negli anziani e nelle donne in età fertile, che possono presentare altre condizioni infiammatorie genito-urinarie e ginecologiche con segni e sintomi simili a quelli dell'appendicite acuta.
Il workup diagnostico può essere migliorato utilizzando scores clinici che coinvolgono l'esame obiettivo del paziente e gli indici di flogosi. Molti scores semplici e intuitivi sono stati utilizzati come algoritmo per stimare il rischio di appendicite acuta, diminuendo la percentuale di appendicectomie negative.
Anche il ruolo della diagnostica per immagini rimane controverso. Infatti, l'ecografia è un esame limitato nei pazienti obesi, in quelli con forte dolore addominale e nelle appendici retrocecali e perforate, mentre la tomografia computerizzata e la risonanza magnetica nucleare sono relativamente costose e non prontamente disponibili in tutti i centri.
I punteggi clinici più utilizzati in Italia e nei Paesi occidentali sono l'appendicitis response inflammatory (AIR) score e l'Alvarado score. Il raja isteri pengiran anak saleha appendicitis (RIPASA) score è un nuovo sistema di punteggio diagnostico sviluppato per la diagnosi di appendicite acuta in Asia e in Medio Oriente. In questi Paesi, è stato dimostrato che lo score possiede un'alta sensibilità, un'alta specificità e un'elevata accuratezza diagnostica.
Questo studio confronta il RIPASA score con l'AIR score e l'Alvarado score in termini di sensibilità, specificità, valore predittivo positivo e accuratezza diagnostica.
Lo studio è stato condotto con pazienti italiani di età superiore a 18 anni sottoposti ad appendicectomia per sospetta appendicite acuta, giunti presso l'Ospedale San Giovanni Addolorata di Roma (Italia) nel periodo compreso tra gennaio 2017 e dicembre 2019.
Al momento del ricovero, sono stati registrati, in un apposito database, i risultati dell'esame obiettivo e quelli degli esami di laboratorio condotti su tutti i pazienti. I dati così ottenuti sono stati utilizzati per calcolare l'AIR score, l'Alvarado score e il RIPASA score. Tutti i pazienti con sospetto diagnostico di appendicite acuta sono stati sottoposti a laparoscopia esplorativa con appendicectomia. In seguito, tali pazienti sono stati divisi in due gruppi, in base alla presenza di appendicectomia positiva o appendicectomia negativa all'esito della diagnosi istopatologica. Il campione retrospettivamente considerato era costituito da 369 pazienti, di cui 213 maschi (57.7%) e 156 femmine (42.3%), con una età media pari a 38.7±16.0 anni. In 320 pazienti (86.7%), il sospetto clinico di appendicite acuta è stato confermato dall'esame istologico con una percentuale di appendicectomie negative pari, quindi, al 13.3%.
Con un cut-off ≥ 7,5, il RIPASA score ha mostrato una sensibilità pari al 90.9%, una specificità del 63.3%, un valore predittivo positivo del 94.2%, un valore predittivo negativo del 51.7% e un'accuratezza diagnostica pari al 87.3%. L'area sotto la curva ROC per il RIPASA score era maggiore di quella evidenziata, sia dall'AIR score che dallo score di Alvarado (0.851 vs 0.796 vs 0.766, rispettivamente). La differenza nell'area sotto la curva ROC del 5.5% tra il RIPASA e l'AIR score era pari a 20 pazienti per i quali è stata posta diagnosi errata di appendicite acuta utilizzando l'AIR score, mentre la differenza dell'8.5% tra RIPASA e Alvarado score era pari a 31 pazienti con diagnosi errata di appendicite acuta.
In conclusione, il nostro studio ha evidenziato che il RIPASA score è uno strumento facile da usare, rapido e non invasivo per la diagnosi di appendicite acuta e mostra un'alta sensibilità, un elevato valore predittivo positivo e un'alta accuratezza diagnostica in una coorte di pazienti italiani con sospetto di appendicite acuta. Lo studio ha inoltre rilevato una sensibilità dello score simile a quella riscontrata nelle popolazioni orientali, tale da ridurre il tasso di appendicectomie negative e anche il ricorso alla diagnostica per immagini.

References

1. Addiss DG, Shaffer N, Fowler BS, Tauxe RV: *The epidemiology of appendicitis and appendectomy in the United States.* Am J Epidemiol, 1990; 132:910-25.

2. Ilves I: *Seasonal variations of acute appendicitis and nonspecific abdominal pain in Finland.* WJG, 2014; 20:4037.

3. Viniol A, Keunecke C, Biroga T, Stadje R, Dornieden K, Bösner S, Donner-Banzhoff N, Haasenritter J, Becker A: *Studies of the symptom abdominal pain: A systematic review and meta-analysis.* Fam Pract, 2014; 31:517-29.

4. De Frances CJ, Hall MJ: *2002 national hospital discharge survey.* Adv Data, 2004; 21:1-29.

5. Gilmore OJ, Browett JP, Griffin PH, Ross IK, Brodribb AJ, Cooke TJ, Higgs MJ, Williamson RC: *Appendicitis and mimicking conditions. A prospective study.* Lancet, 1975; 2:421-4.

6. Dal F, Cicek Y, Pekmezci S, Kocazeybek B, Tokman HB, Konukoglu D, Şimşek O, Taner Z, Sirekbasan S, Uludağ SS: *Role of Alvarado score and biological indicators of C-reactive protein, procalicitonin and neopterin in diagnosis of acute appendicitis.* Ulus Travma Acil Cerrahi Derg, 2019; 25(3):229-37.

7. Andersson M, Andersson RE: *The appendicitis inflammatory response score: A tool for the diagnosis of acute appendicitis that outperforms the Alvarado score.* World J Surg, 2008; 32:1843-9.

8. Alvarado A: *A practical score for the early diagnosis of acute appendicitis.* Ann Emerg Med, 1986; 15:557-64.

9. Sammalkorpi HE, Mentula P, Leppäniemi A: *A new adult appendicitis score improves diagnostic accuracy of acute appendicitis: A prospective study.* BMC Gastroenterol, 2014; 14:114.

10. Sippola S, Virtanen J, Tammilehto V, Sippola S, Grönroos J, Hurme S, Niiniviita H, Lietzen E, Salminen P: *The accuracy of low-dose computed tomography protocol in patients with suspected acute appendicitis: The opticap study.* Ann Surg, 2020; 271(2):332-38.

11. Bachur RG, Hennelly K, Callahan MJ, Chen C, Monuteaux MC: *Diagnostic imaging and negative appendectomy rates in children: effects of age and gender.* Pediatrics, 2012; 129:877-84.

12. Chong CF, Adi MI, Thien A, Suyoi A, Mackie AJ, Tin AS, Tripathi S, Jaman NH, Tan KK, Kok KY, Mathew VV, Paw O, Chua HB, Yapp SK: *Development of the RIPASA score: A new appendicitis scoring system for the diagnosis of acute appendicitis.* Singapore Med J, 2010; 51:220-25.

13. Chong CF, Thien A, Mackie AJA, Tin AS, Tripathi S, Ahmad MA, Tan LT, Ang SH, Telisinghe PU: *Comparison of RIPASA and Alvarado scores for the diagnosis of acute appendicitis.* Singapore Med J, 2011; 52: 340-44.

14. Bhangu A, Søreide K, Di Saverio S, Hansson Assarsson J, Thurston Drake F: *Acute appendicitis: Modern understanding of pathogenesis, diagnosis, and management.* Lancet, 2015; 386:1278-87.

16. Gomes CA, Abu-Zidan FM, Sartelli M, Coccolini F, Ansaloni L, Baiocchi GL, Kluger Y, Di Saverio S, Catena F: *Management of appendicitis globally based on income of countries (MAGIC) study.* World J Surg, 2018; 42:3903-10.

17. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, Boermeester M, Sartelli M, Coccolini F, Tarasconi A, De' Angelis N, Weber DG, Tolonen M, Birindelli A, Biffl W, Moore EE, Kelly M, Soreide K, Kashuk J, Ten Broek R, Gomes CA, Sugrue M, Davies RJ, Damaskos D, Leppäniemi A, Kirkpatrick A, Peitzman AB, Fraga GP, Maier RV, Coimbra R, Chiarugi M, Sganga G, Pisanu A, De' Angelis GL, Tan E, Van Goor H, Pata F, Di Carlo I, Chiara O, Litvin A, Campanile FC, Sakakushev B, Tomadze G, Demetrashvili Z, Latifi R, Abu-Zidan F, Romeo O, Segovia-Lohse H, Baiocchi G, Costa D, Rizoli S, Balogh ZJ, Bendinelli C, Scalea T, Ivatury R, Velmahos G, Andersson R, Kluger Y, Ansaloni L, Catena F: *Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines.* World J Emerg Surg, 2020; 15(1):27.

18. Singh K, Chitrangada K: *Comparative study of diagnostic accuracy of modified Alvarado score and ultrasonography in acute appendicitis.* IOSR-JDMS, 2014; 13:36-40.

19. Nasiri S, Mohebbi F, Sodagari N, Hedayat A: *Diagnostic values of ultrasound and the modified Alvarado scoring system in acute appendicitis.* Int J Emerg Med, 2012; 5(1):26.

20. Zosimas D, Lykoudis PM, Burke J, Leung P, Strano G, Shatkar V: *Is ultrasound a reliable diagnostic tool for acute appendicitis? A single centre experience.* Ann Ital Chir, 2017; 88:557-61.

21. Altomare M, Cimbanassi S, Chiara O, Salvi PF: *Acute appendicitis. Update of clinical scores*. Ann Ital Chir, 2019; 90:231-37.

22. Coursey CA, Nelson RC, Patel MB, Cochran C, Dodd LG, Delong DM, Beam CA, Vaslef S: *Making the diagnosis of acute appendicitis: do more preoperative CT scans mean fewer negative appendectomies? A 10-year study.* Radiology, 2010; 254:460-68.

23. Laméris W, van Randen A, van Es HW, van Heesewijk JP, van Ramshorst B, Bouma WH, ten Hove W, van Leeuwen MS, van Keulen EM, Dijkgraaf MG, Bossuyt PM, Boermeester MA, Stoker J: *Optima study group: Imaging strategies for detection of urgent conditions in patients with acute abdominal pain: diagnostic accuracy study.* BMJ, 2009; 338:b2431.

24. Bhangu A; *Rift study group on behalf of the west midlands research collaborative: Evaluation of appendicitis risk prediction models in adults with suspected appendicitis.* Br J Surg, 2020; 107(1):73-86.

25. Levine CD, Aizenstein O, Lehavi O, Blachar A: *Why we miss the diagnosis of appendicitis on abdominal CT: Evaluation of imaging features of appendicitis incorrectly diagnosed on CT.* AJR Am J Roentgenol, 2005; 184(3):855-59.

26. Jaschinski T, Mosch C, Eikermann M, Neugebauer EAM: *Laparoscopic versus open appendectomy in patients with suspected appendicitis: a systematic review of meta-analyses of randomised controlled trials.* BMC Gastroenterol, 2015; 15-48.

27. Yu M-C, Feng Y, Wang W, Fan W, Cheng H-T, Xu J: *Is laparoscopic appendectomy feasible for complicated appendicitis? A systematic review and meta-analysis.* Int J Surg, 2017; 40:187-97.14.

28. Sammalkorpi HE, Mentula P, Savolainen H, Leppäniemi A: *The Introduction of adult appendicitis score reduced negative appendectomy rate.* Scand J Surg, 2017; 106(3):196-201.

29. Kalan M, Talbot D, Cunliffe WJ, Rich AJ: *Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: A prospective study.* Ann R Coll Surg Engl, 1994; 76:418-19.

30. Coleman JJ, Carr BW, Rogers T, Field MS, Zarzaur BL, Savage SA, Hammer PM, Brewer BL, Feliciano DV, Rozycki GS: *The Alvarado score should be used to reduce emergency department length of stay and radiation exposure in select patients with abdominal pain.* J Traum Acute Care Surg, 2018; 84:946-50.

31. Andersson M, Kolodziej B, Andersson RE; *Strappscore study group: Randomized clinical trial of appendicitis inflammatory response score-based management of patients with suspected appendicitis: Appendicitis inflammatory response scorebased management of suspected appendicitis.* Br J Surg, 2017; 104:1451-461.

32. Kularatna M, Lauti M, Haran C, MacFater W, Sheikh L, Huang Y, McCall J, MacCormick AD: *Clinical prediction rules for appendicitis in adults: Which is best?* World J Surg, 2017; 41:1769-81.

33. Frountzas M, Stergios K, Kopsini D, Schizas D, Kontzoglou K, Toutouzas K: *Alvarado or ripasa score for diagnosis of acute appendicitis? A meta-analysis of randomized trials.* International Journal of Surgery, 2018; 56:307-14.

34. Chong CF, Thien A, Mackie AJA, Tin AS, Tripathi S, Ahmad M, Tan LT, Ang SH, Telisinghe PU: *Evaluation of the Ripasa Score: A new scoring system for the diagnosis of acute appendicitis.* Brueni Int Med J, 2010; 6:17-26.

35. Butt MQ, Chatha SS, Ghumman AQ, Farooq M: *Ripasa score: A new diagnostic score for diagnosis of acute appendicitis.* J Coll Physicians Surg Pak, 2014; 24(12):894-7.

36. Khalil OA: *Using of the modified ripas score in diagnosis of acute appendicitis to decrease use of abdominal computed tomography.* Egyptian J Surg, 2013; 32(2):86-90.

37. NN, Mohammed A, Shanbhag V, Ashfaque K, SAP: *A comparative study of ripasa score and alvarado score in the diagnosis of acute appendicitis.* J Clin Diagn Res, 2014; 8(11):NC03-5.

38. Malik MU, Connelly TM, Awan F, Pretorius F, Fiuza-Castineira C, El Faedy O, Balfe P: *The ripasa score is sensitive and specific for the diagnosis of acute appendicitis in a western population.* Int J Colorectal Dis, 2017; 32:491-7.