

Original article

Visual analog scales can assess the severity of rhinitis graded according to ARIA guidelines

Background: The allergic rhinitis and its impact on asthma (ARIA) guidelines provide a new classification of allergic rhinitis, but a quantitative analysis for severity assessment is lacking.

Objective: To study whether a visual analog scale (VAS) for global rhinitis symptoms could be used to assess the disease severity according to ARIA.

Methods: Three thousand fifty-two allergic rhinitis patients seen in primary care were tested. Fifty three per cent had an objective diagnosis of allergy and 58% of the patients were treated. Patients were categorized according to ARIA guidelines. The severity of nasal symptoms was assessed using a VAS. Quality of life was measured using the rhinoconjunctivitis quality of life questionnaire (RQLQ).

Results: Severity had more impact on VAS levels than duration: mild intermittent rhinitis (3.5, 2.4–5.0 cm), mild persistent rhinitis (4.5, 3.2–5.6 cm), moderate/severe intermittent rhinitis (6.7, 5.3–7.7 cm) and moderate/severe persistent rhinitis (7.2, 6.1–8.2 cm). The receiver operating characteristic curve results showed that patients with a VAS of under 5 cm could be classified as 'mild' rhinitis (negative predictive value: 93.5%) and those with a VAS of over 6 cm as 'moderate/severe' rhinitis (positive predictive value: 73.6%). Receiver operating characteristic curves and a logistic regression showed that current treatment and allergy diagnosis have no effect on the assessment of rhinitis severity using VAS. Visual analog scale and the RQLQ global score were significantly correlated ($\rho = 0.46$; $P < 0.0001$).

Conclusion: A simple and quantitative method (VAS) can be used for the quantitative evaluation of severity of allergic rhinitis.

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Key words: allergic rhinitis; allergic rhinitis and its impact on asthma; rhinoconjunctivitis quality of life questionnaire; severity; visual analog scale.

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The allergic rhinitis and its impact on asthma (ARIA) recommendations have devised a new classification for allergic rhinitis (1–3). Intermittent and persistent rhinitis were proposed to replace seasonal and perennial allergic rhinitis (4–9). The ARIA guidelines have also proposed a new grading of severity (mild and moderate/severe).

Allergic rhinitis is associated with impairments in quality of life, work and school productivity (2, 10–14). Patients may also be bothered by sleep disorders, emotional problems, impairment in activities and social functioning (15, 16). These reasons explain why, in the ARIA guidelines, the severity of allergic rhinitis is based upon both QOL and symptom severity.

However, the ARIA scoring system uses several questions and cannot be quantified. Moreover, when applied

to general practice, a simpler evaluation is favoured. Visual analog scales (VAS) are quantitative measures largely validated in many diseases (17, 18). These scales have been extensively used to assess the severity of rhinitis (19–23) as well as the efficacy of therapeutic interventions (22, 24–26). The use of VAS has also been recently proposed by the joint task force on practice parameters for the symptom severity assessment of allergic rhinitis (27).

A large study carried out on 3052 patients with allergic rhinitis, seen in primary care, assessed the severity of allergic rhinitis using the ARIA guidelines (1). The first part of the study showed that the severity of rhinitis had more impact on quality of life, sleep, daily activities and work performance than the duration of rhinitis (28).

This study presents the secondary outcome measures of the rhinitis trial (28). It assessed whether a VAS for global rhinitis symptoms could be used to assess the severity of the disease according to the ARIA guidelines (1).

Abbreviations: ARIA, allergic rhinitis and its impact on asthma; AUC, area under the curve; QOL, quality of life; ROC, receiver operating characteristic; RQLQ, rhinoconjunctivitis quality of life questionnaire; VAS, visual analog scale.

Methods

Patients

Three thousand fifty-two patients with age ranging from 18 to 70 years were recruited from 811 general practitioners (28) (Fig. 1). All patients fulfilled the following inclusion criteria: (i) patients who had been suffering from allergic rhinitis for at least the past 3 years; (ii) their diagnosis of allergic rhinitis was based upon symptoms according to criteria proposed in the International Consensus of Rhinitis (10). Fifty three per cent of subjects had a diagnosis of allergy determined by skin-prick test, allergen-specific IgE or Phadiatop® (Pharmacia Diagnostica AB, Uppsala, Sweden). Fifty eight per cent of the patients were currently being treated for allergic rhinitis symptoms. Among them, 82.4% were taking oral H1-antihistamines, 22.8% intranasal corticosteroids and 19.4% had other treatments. Medications were not stopped before VAS was performed.

Patients were enrolled over a period of 1 year and were selected from all regions of France to rule out any geographic or seasonal parameters.

Interventions

Allergic rhinitis and its impact on asthma guidelines were used to classify patients into four groups: mild intermittent (MI), moderate/severe intermittent (SI), mild persistent (MP) and moderate/severe persistent (SP), using the severity of symptoms and QOL (1).

A VAS ranging from 0 ('nasal symptoms, not at all bothersome') to 10 cm ('nasal symptoms, extremely bothersome') was used to assess the severity of combined nasal symptoms. We did not use a VAS for individual symptoms such as nasal obstruction, rhinorrhoea, sneezing and nasal pruritus as previously proposed (22, 27).

Quality of life was assessed by the rhinoconjunctivitis quality of life questionnaire (RQLQ) (29). Only the overall score was used in this study.

Statistical analysis

Although some of the variables were normally distributed, others were not. We therefore chose to use nonparametric statistics for all the variables and results were expressed in medians and 25–75

percentiles. The correlation between VAS and the overall RQLQ score was carried out using the Spearman rank correlation.

Treatment and rhinitis diagnosis may be confounding factors. Since allergy was confirmed in only 53.8% of the patients, we made a sub-analysis between the patients with a proved diagnosis of allergy and those without confirmed allergy diagnosis. As 59% of the patients were being treated at the time of inclusion, we made a subanalysis between the currently treated and untreated patients. A logistic regression (logit, stepwise model) (30) assessed the severity of ARIA classification, including the following criteria: VAS score, diagnosed/undiagnosed patients and treated/untreated patients.

The receiver operating characteristic (ROC) curve summarizes the performance of the VAS classifier across the range of possible VAS scores (from 0 to 10 cm) (31–33). Depending on the cut-off level, patients were classified as having mild-to-moderate/severe rhinitis. The gold standard used for severity was the ARIA classification. For each level, sensitivity, specificity and positive and negative predictive values were defined. The ROC curve was used to reach an optimum decision. Moreover, as the proportion of patients without diagnosis of rhinitis is important – as well as the proportion of untreated patients (diagnosed/undiagnosed and treated/untreated) – it was decided to perform separate ROC comparison curves for the different groups. Areas under the ROC curves were compared using the Mann–Whitney *U*-test.

Results

Demographic characteristics of the patients

The demographic characteristics of the patients are presented in Table 1. The patients were distributed in the four ARIA classes, but most patients had moderate/severe rhinitis.

Visual analog scale results

Over 95% of the patients were able to fill in the VAS scale. The overall VAS results are presented in Fig. 2. Severity had more impact on VAS levels than duration:

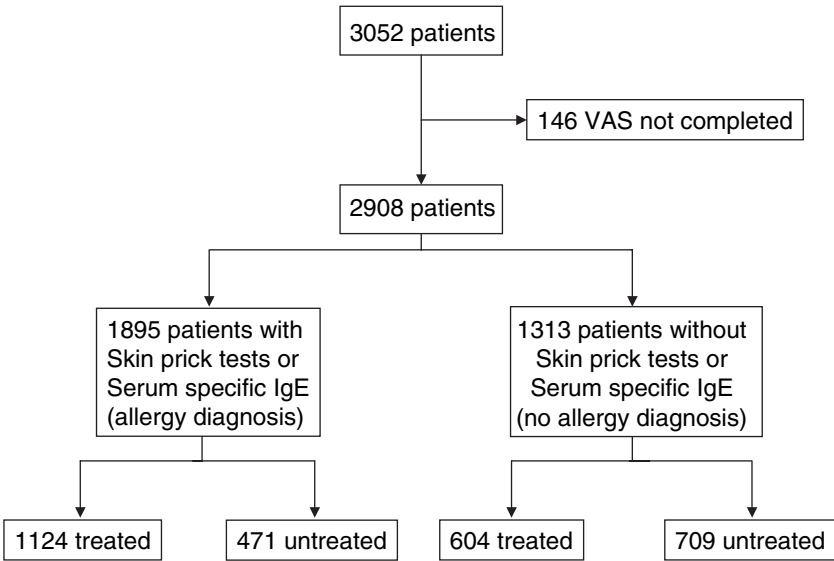


Figure 1. Flow chart of patients' distribution.

Table 1. Demographic characteristics of the patients

	All patients	Mild intermittent (MI)	Moderate/severe intermittent (SI)	Mild persistent (MP)	Moderate/severe persistent (SP)	P-value*	Bonferroni–Dunn <i>post hoc</i> analysis			
							MI/SI	MI/MP	MP/SP	SI/SP
Number (%)	3052	109 (3.9)	1169 (41.8)	86 (3.1)	1431 (51.2)	NA				
Age (years)	39 (30–51)	41 (31–55)	40 (30–51)	43 (31–56)	39 (29–50)	0.03	NS	NS	NS	NS
Males (%)	45.3	42.6	45.8	45.2	45.0	NS	NS	NS	NS	NS
Socioeconomic status (%)										
Farmer	2.9	3.7	3.6	1.2	2.3	NS	NS	NS	NS	NS
Craftsman, shopkeeper	6.1	7.3	6.7	3.5	5.7					
Worker	7.2	5.5	6.9	10.5	7.4					
Executive, intellectual, employee	51.6	52.3	50.2	44.1	53.0					
Unemployed	23.1	27.5	23.6	30.2	22.2					
Other	9.1	3.7	9.0	10.5	9.4					
Smokers and ex-smokers	33.1	25.9	34.2	38.8	32.4	NS	NS	NS	NS	NS
Duration of rhinitis (years)	7 (4–10)	6 (3–15)	5 (3–10)	7 (4–15)	8 (4–12)	<0.001	NS	NS	NS	<0.01
Allergy diagnosis†	55.4	38.9	47.5	51.2	63.1	<0.001	NS	NS	NS	<0.01
Global RQLQ score	2.8 (2.1–3.5)	1.7 (1.1–2.4)	2.7 (2.1–3.4)	2.1 (1.5–2.6)	3.0 (2.3–3.6)	<0.001				

NA, not applicable. Results are given in percentages or medians and 25–75 percentiles.

*Chi-square and Kruskal–Wallis tests used for qualitative and quantitative variables.

†Allergy diagnosis determined by skin-prick tests and/or serum-specific IgE.

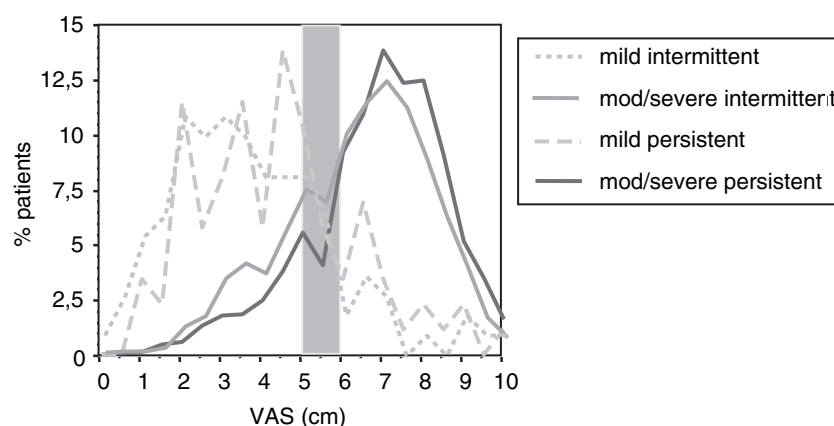


Figure 2. Distribution of patients according to ARIA classes.

MI rhinitis (median VAS level, 25–75 percentiles: 3.5, 2.4–5.0 cm), MP rhinitis (4.5, 3.2–5.6 cm), moderate/SI rhinitis (6.7, 5.3–7.7 cm) and moderate/SP rhinitis (7.2, 6.1–8.2 cm).

The VAS was equal or under 5.0 cm in 77.1% of the patients with MI rhinitis, 65.1% of the patients with MP rhinitis, 22.4% of those with moderate/SI rhinitis and 15.4% of those with moderate/SP rhinitis.

The VAS was equal or over 7.0 cm in 6.4% of the patients with MI rhinitis, 10.5% of those with MP rhinitis, 40.1% of those with moderate/SI rhinitis and 53.4% of those with moderate/SP rhinitis.

Effect of allergy diagnosis on visual analog scale results

Patients with a diagnosis of allergy had slightly but significantly ($P < 0.001$) greater VAS levels than those

who did not have a diagnosis of allergy (7.0, 5.6–8.0 cm and 6.7, 5.0–7.8 cm, respectively).

Effect of treatment on visual analog scale results

Patients undergoing treatment had slightly but significantly ($P = 0.004$) greater VAS levels than untreated patients (7.0, 5.5–8.0 cm and 6.7, 5.0–7.9 cm, respectively).

Logistic regression analysis

The modelization of the severity of rhinitis using a logistic regression showed that current treatment and allergy diagnosis have no effect on the assessment of rhinitis severity (VAS: $P < 0.0001$, all others: NS).

Receiver operating characteristic curves

It was found that patients with or without rhinitis treatment (AUC 0.832 and 0.837, respectively, $P = 0.92$) and with or without a definite diagnosis of allergy (AUC 0.829 and 0.837, respectively, $P = 0.88$) had similar if not identical ROC curves. The overall ROC curve AUC is 0.835 (Fig. 3).

Positive and negative predictive values varied depending on the level of VAS (Table 2). The negative predictive values (the proportion of patients with mild rhinitis among those with a VAS score under the cut-off level) ranged from 93.1% to 94.3% for a VAS level between 4.0 and 7.0 cm. On the contrary, the positive predictive values (the proportion of patients with a moderate/severe rhinitis among those with a VAS score over the cut-off level) ranged from 57.1% to 73.3% for a VAS level between 5.0 and 6.0 cm. From these results, patients with a VAS level under 5 cm are classed in the 'mild' category and those with a VAS level over 6 cm in the 'moderate/severe' category. Using a different cut-off level does not change significantly the results. If mild is between 5 and 6 cm, there would be a very small decrease of negative predictive value (57.1–56.2%) and a slight increase of the positive predictive value (93.5–94.3%).

Correlation between RQLQ and visual analog scale

Two thousand one hundred fourteen patients were able to fill in the RQLQ questionnaire. The rate of response to the different domains ranged from 85.5% to 92.0%. There was a highly significant correlation between the overall RQLQ score and the VAS level (Fig. 4). Although most patients with a VAS of under 4 cm had an RQLQ score of under 3, many patients with a VAS of over 8 cm had an RQLQ score of under 3. Moreover, there is a large RQLQ score scatter for each VAS level.

Discussion

In the present study carried out on a large number of patients consulting in primary care, it was found that

Table 2. Results of the receiver operating characteristic curve

VAS level (cm)	Sensitivity	Specificity	Positive predictive value (%)	Negative predictive value (%)
4.0	99.8	3.6	93.2	63.6
4.5	99.8	6.7	93.4	72.2
5.0	99.5	8.2	93.5	57.1
5.5	99.2	12.8	93.8	54.3
6.0	98.8	20.0	94.3	56.5
6.5	98.0	24.1	94.5	48
7.0	97.1	29.7	94.9	43.6

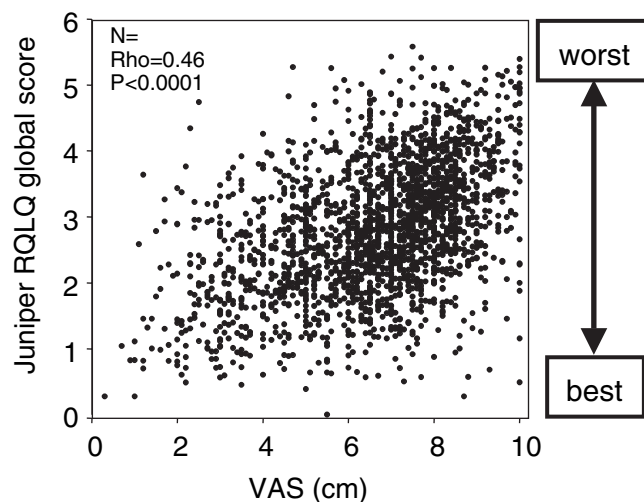


Figure 4. Distribution of the global RQLQ score depending on VAS.

VAS can be used as a simple and quantitative method for the assessment of rhinitis severity in both intermittent and persistent rhinitis and in untreated or treated patients.

In this study, a very large group of patients was tested. These patients were seen in primary care and most of them had moderate/severe symptoms according to the ARIA guidelines. This result was surprising as the patients were seen in primary care. The imbalance between the number of patients with mild and moderate/severe rhinitis may have represented a methodological

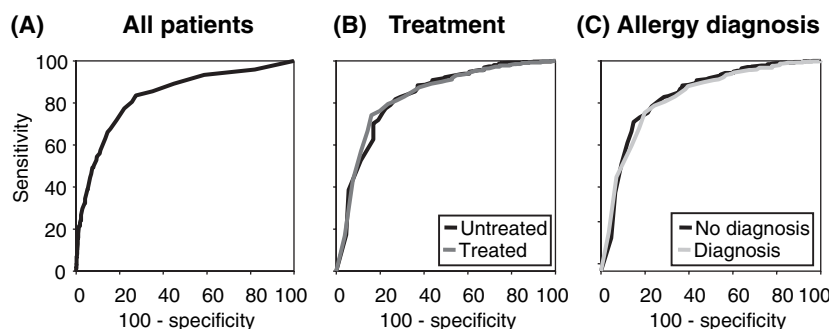


Figure 3. Receiver operating characteristic curves. (A) All patients, (B) untreated and treated patients and (C) patients with and without a proved diagnosis of allergy.

problem of the study, which is counterbalanced by the high number of patients tested in the mild rhinitis group ($n = 195$).

This study confirms previous studies in rhinitis where VAS was used to assess the severity of rhinitis (19–23). However, this is the first time it has been used on patients classified according to ARIA.

We used a simple assessment of VAS. In a subjective symptom like pain, VAS is recommended by guidelines for the assessment of severity (34, 35). In the AAAAI/ACAAI practice parameters, several VAS scales are used for the different rhinitis symptoms (27). We previously used this type of multiple scale (22) but, in the present study, we used only a single scale with a question related to QOL as such a simple question would be easier to use in primary care. It appears from the results that this scale is easy to use as all of the patients enrolled were able to reply and it can be used in primary care. We therefore favour such a single-question scale. Other studies in different languages are being held to confirm the possible use of this scale in different countries and communities.

We propose a cut-off level of 5 cm to discriminate between mild and moderate/severe patients with allergic rhinitis because of the results of the ROC curve and simplicity. With this cut-off level of 5 cm, the negative predictive value is 93.5% and the positive predictive value is 57.1%. A more accurate cut-off level, but more difficult to remember, would have been 5.5 cm, which corresponds to the intersections of the curves (MI rhinitis with moderate/severe and MP with moderate/severe). At that level, the negative predictive value was 93.4% and a positive predictive value 73.6%. Moreover, studies in other countries will help to define better the cut-off value.

In the present study, around half of the patients did not have a definite diagnosis of allergy. This is the current practice in primary care. Although patients with a diagnosis of allergy had a slightly but significantly greater severity of rhinitis assessed by ARIA, there was no effect of diagnosis on the logistic regression analysis and the diagnosis of allergy did not change the ROC curves. Thus, VAS can be used in general practice even when the allergy diagnosis has not been made using objective tests.

In asthma, the control level is independent of asthma medications (36, 37). Although such an independent relationship was suspected in a former study in allergic rhinitis with a different patient group (5), this very important finding was confirmed in the present study in which we found that the severity of rhinitis is independent of its treatment. In the present study, although patients with a current treatment for rhinitis had a slightly but significantly greater severity of rhinitis as assessed by ARIA, there was no treatment effect on the logistic regression analysis and the ROC curves. We therefore confirmed the results of the study (5) and found that VAS can be used to assess the severity of rhinitis in treated and untreated patients. In the present study, the prescribed as needed (prn) or continuous use of medications was not recorded. However, in the study of White et al. (38), the prn or prolonged use of medications did not change the control of the disease.

The classification of the severity of rhinitis can be carried out using symptom scores for all symptoms of rhinitis or quality of life (27). In the present study, patients were classified according to the ARIA criteria, which combine symptom scores and the impact of rhinitis on daily activities and sleep (1). In this study, VAS and the quality of life measurement were correlated, but the correlation is not very high. This result was already observed for asthma as quality of life measures components that are not assessed by other measures (39, 40). However, there is a large scatter between VAS and RQLQ results. Moreover, the median RQLQ scores were not very high in patients with moderate/severe rhinitis. However, in many other European studies, the RQLQ score was always around 3.0 in patients with moderate/severe rhinitis (22, 41–43).

Visual analog scale can guide the treatment of patients with rhinitis, as shown in another study (22). However, in the present study, we did not assess the test–retest validity of the VAS neither did we assess changes of VAS depending on treatment. This is currently being carried out separately.

This study shows that a simple and quantitative method (VAS) can be used for the evaluation of allergic rhinitis severity in primary care.

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