

Skin reactivity and specific IgE levels in the evaluation of allergic sensitivity to common allergens for epidemiological purposes

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Summary

An investigation was conducted to test the validity of the skin-prick test (SPT) with eleven common allergens (Lofarma series proposed by Italian National Research Council for epidemiological studies) as a method for predicting the presence of specific antibodies in serum. The relationship between SPT, evaluated by two different methods (MWD = mean weal diameter, AHWR = allergen histamine weal ratio), and specific IgE levels (RAST) has been investigated in 101 patients tested consecutively for suspected allergic disease. Sensitivity, specificity and overall efficiency were assessed for different criteria of SPT positivity (≥ 4 mm or ≥ 5 mm using MWD; ++ or +++ using AHWR). For pollens and moulds, a weal diameter ≥ 5 mm gave better results than 4 mm, whereas for mites a MWD ≥ 4 mm showed a better sensitivity and overall efficiency than 5 mm. Danders showed low sensitivity when either 5 or 4 mm criterion was considered. AHWR evaluation gave no better results, except for animal danders. Correlation coefficients between weal size and RAST class showed a good relationship for mites and pollens using both methods of SPT evaluation; a moderate relationship was observed with MWD criterion for moulds and with AHWR for danders.

We conclude that a weal diameter ≥ 5 mm can be assumed to predict RAST positivity for pollens and moulds, and for mites, a weal ≥ 4 mm can be a more accurate criterion. The poor correlation between weal diameter and RAST positivity for such allergens as animal danders and moulds suggests that in these cases SPT should be associated to specific serum IgE evaluation to prove allergic sensitivity.

Introduction

The identification of atopic status in epidemiological studies can be performed by several means, such as clinical history, skin test or specific IgE evaluation. The decision

as to the choice of test depends on availability, cost and risk or discomfort for the patient. The relationship between the various tests is well known [1-4], but generally there is a mild discrepancy between the results obtained using the three types of evaluation mentioned above. Family or personal history is the least sensitive method, whereas specific IgE measurement is the most expensive method and requires suitable laboratories and technicians. For these reasons, the skin-prick test (SPT) represents an easy method to ascertain the presence of atopy. It is commonly used for epidemiological studies [5,6], and has shown a good sensitivity and specificity with respect to intradermal test [6]. Different methods of evaluation of SPT reactions are commonly used and the criteria of positivity are also different when clinical and epidemiological purposes are considered [7]. In Italy, the National Research Council (CNR) suggests that a mean weal diameter ≥ 5 mm can be considered as positive in the attempt to predict atopic status.

In order to verify the value of SPT to prove atopy in epidemiological studies we have compared the results of the test, evaluated by two different methods, with specific serum IgE levels in 101 subjects observed consecutively in our laboratory for suspected allergic disease.

Materials and methods

We examined 101 patients with suspected allergic disease by means of SPT performed with eleven common airborne allergens (cat and dog hairs, horse dander, *Dermatophagoides pteronyssinus* and *farinae*, *Parietaria officinalis*, graminaceae mix, compositae mix, *Olea europea*, *Aspergillus fumigatus*, *Alternaria tenuis* (Lofarma series proposed by CNR for epidemiological studies)), and negative and positive controls (diluent and histamine 1:100 respectively). Drugs which could affect skin reactivity (for example, anti-histamines) were withdrawn at least 48 hr before performing SPT. Specific serum IgE levels were evaluated by means of Radio Allergo Sorbent Test (Phadebas RAST, Pharmacia Diagnostics). This test allows the detection of specific IgE in the serum, and according to the level of IgE the sera can be classified as: RAST class 0 = negative; RAST class 1 = dubious; RAST class 2 = weakly positive; RAST class 3 and 4 = strongly positive. In our study, sera with RAST class ≥ 2 were considered as positive. RAST was performed when the same allergen gave a weal diameter ≥ 1 mm.

SPT was performed on the volar surfaces of the forearms using a blood lancet, and after 20 min [5,8,9] the results were evaluated by two different methods:

(i) measurement of mean weal diameter (MWD), $(D+d)/2$ subtracting the negative control, where D is the greatest diameter and d the perpendicular to it; (ii) allergen/histamine weal ratio (AHWR) where, - = negative control; $+ < 1/2$ histamine weal; $++ \geq 1/2$ histamine weal; $+++ \geq 1$ histamine weal. Reproducibility in performing SPT was considered good. Different criteria of positivity using the two methods were compared with RAST class, and sensitivity, specificity and overall efficiency were calculated for each group of allergens as follows: sensitivity = ratio between number (N) of positive SPT with positive RAST and total N of positive RAST; specificity = ratio between N of negative SPT with negative RAST and total N of negative RAST; overall efficiency = ratio between N of positivities to both SPT and RAST + N of negativities to both SPT and RAST and total N of RAST. Correlation between weal size, evaluated with the two methods, and RAST results was calculated.

Results

The number of positive skin tests ($\text{MWD} \geq 5$ mm, according to the suggestions of CNR) observed in all patients was thirty-eight for pollens, thirty-one for mites, four for danders and seven for moulds; in these groups the percentage RAST positivity was 81.5%, 90.3%, 75% and 42.8% respectively. In Table 1 we report sensitivity, specificity and overall efficiency of the test for each group of allergens when the criteria of positivity are respectively 4 mm, 5 mm, ++ and +++. For moulds a weal diameter of 5 mm gave the best overall efficiency. In the case of mites a diameter of 4 mm showed better sensitivity than 5 mm, but specificity was slightly lower and, however, overall efficiency was greater when a 4 mm criterion of positivity was used. A weal diameter of 5 mm gave the best result for pollens. Danders showed low sensitivity when either a 4 or 5 mm weal was considered, although specificity was high in both cases. Sensitivity and

Table 1. Sensitivity, specificity and overall efficiency for different criteria of SPT positivity

	Sensitivity	Specificity	Overall efficiency
Mites ≥ 4 mm	42/59 0.71	38/48 0.79	80/107 0.75
≥ 5 mm	28/59 0.47	45/48 0.94	73/107 0.68
++	31/40 0.77	29/39 0.74	60/79 0.76
+++	8/40 0.20	38/39 0.97	46/79 0.58
Pollens ≥ 4 mm	35/37 0.95	37/56 0.66	72/93 0.77
≥ 5 mm	31/37 0.84	49/56 0.87	80/93 0.86
++	26/27 0.96	36/49 0.73	62/76 0.82
+++	12/27 0.44	48/49 0.98	60/76 0.79
Moulds ≥ 4 mm	4/4 1.0	34/46 0.74	38/50 0.76
≥ 5 mm	3/4 0.75	42/46 0.91	45/50 0.90
++	2/3 0.66	28/40 0.70	30/43 0.70
Danders ≥ 4 mm	5/11 0.45	48/57 0.84	53/68 0.78
≥ 5 mm	3/11 0.27	56/57 0.98	59/68 0.87
++	8/9 0.89	31/44 0.70	39/53 0.74
+++	1/9 0.11	43/44 0.97	44/53 0.83

specificity for the different criteria of positivity (≥ 4 mm or ≥ 5 mm weal) in the different groups of allergens are reported in Fig. 1. The results obtained by the ++ criterion were similar to those derived from 4 mm criterion when specificity and overall efficiency were considered. For danders, ++ criterion showed a better sensitivity than the other criteria. The +++ criterion gave a good specificity but a very low sensitivity.

Correlation coefficients between weal size (evaluated by two different methods) and RAST class are reported in Table 2. A good relationship was observed for mites and pollens using both methods of evaluation of SPT. For moulds, a moderate relationship was observed only when MWD was chosen to assess SPT positivity. RAST class of animal danders showed a better correlation with AHWR than with MWD. Figures 2 and 3 show the relationship between mean weal diameter and RAST positivity (expressed as % of binding) for *Parietaria officinalis* and animal danders respectively.

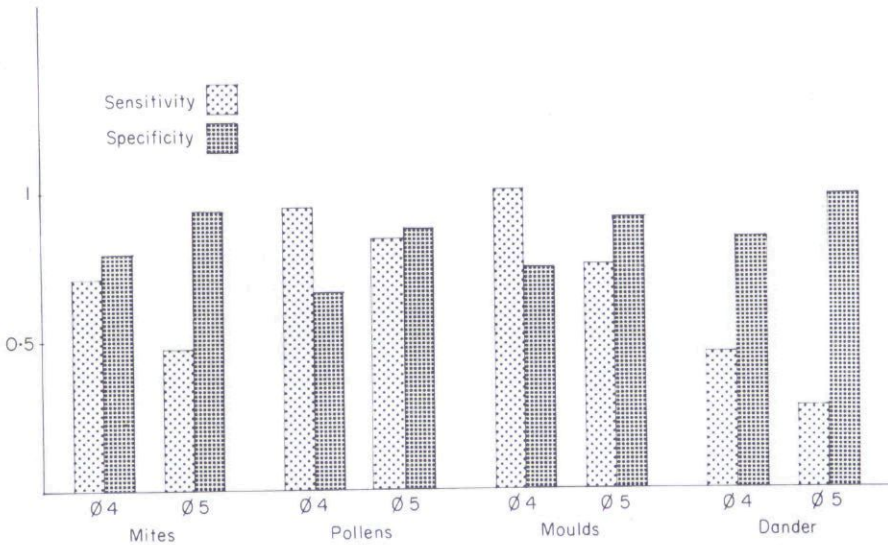


Fig. 1. Sensitivity and specificity for different criteria of positivity (mean weal diameter greater than 4 or 5 mm) in the different groups of allergens.

Table 2. Correlation coefficients between weal size and RAST class

	Mean weal diameter	Allergen/histamine ratio
Mites	0.56*	0.61*
Pollens	0.64*	0.69*
Graminaceae	0.69*	0.73*
<i>Parietaria officinalis</i>	0.69*	0.75*
Danders	0.24	0.48**
Moulds	0.38**	0.24

* $P < 0.001$, ** $P < 0.01$.

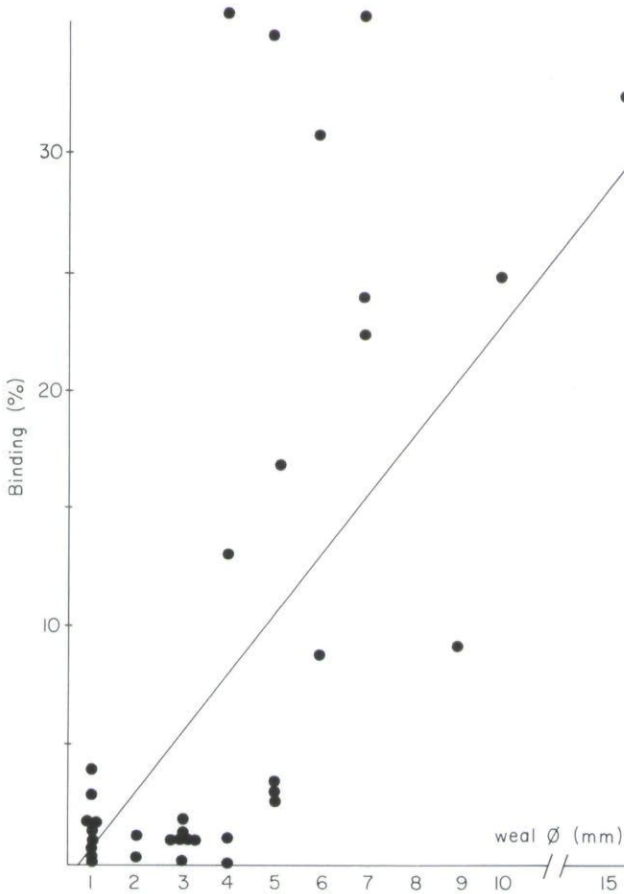
Finally, the mean weal diameter of SPT with RAST class 3 or 4 was greater for pollens (6.8 mm) than for the other allergens (4.8 for mites, 4.7 for moulds and 3.5 for danders).

Discussion

In epidemiological studies SPT are commonly used to diagnose atopy, but different criteria of evaluation have been utilized. The relationship between weal size and RAST score has not been studied sufficiently in respect of various allergens and the different skin reactions they might induce.

In our study the skin reaction given by pollens was greater than that given by the other allergens when the highest RAST classes were considered. This fact may be influenced by the different methods used for the preparation and purification of allergenic extracts, and there may be a higher variability associated with the measurement of smaller weals.

In the evaluation of SPT the criterion to be used is the one showing the best



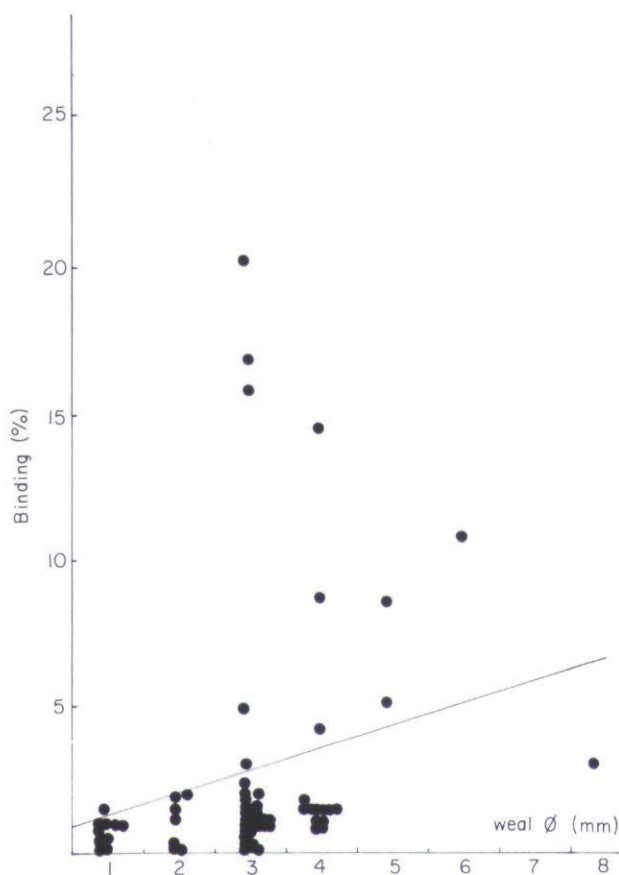


Fig. 3. Relationship between mean weal diameter and RAST positivity (% of binding) for animal danders.

for SPT and RAST. These results suggest that, for danders and moulds, SPT should be associated with specific serum IgE levels evaluation to prove allergic sensitivity.

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