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The Results of Skin Prick Testing in Patients with Allergic Rhinitis: A Comparison between a Multiple Lancet Device and a Single Lancet

Aşkın Ateş, Gülay Kınıklı, Murat Turgay, Nergis Aydoğan and Murat Duman

SUMMARY **Skin prick testing (SPT) is widely used in the assessment of allergic disorders. Different SPT techniques are widely used. The aim of this study was to compare the response to SPT using a multiple lancet device (MLD) with the results of a single lancet (SL). Fifty patients with allergic rhinitis were included in this study. Initially, SPT was performed by a SL technique. After one week SPT was repeated using the MLD on all patients. The patients were tested with a panel containing 19 specific allergens including grass pollen, tree pollen, house dust mites, weed pollen allergen extracts, histamine and a negative control. The skin responses were recorded after 15 minutes for each device by measuring the diameter of the wheal and the erythema. The skin wheal responses for grass pollen, tree pollen, weed pollen and house dust mite allergen extracts obtained using the SL were generally significantly larger than those using the MLD. The comparison between the MLD and the SL methods revealed that SPT was positive with SL and negative with MLD in 176 tests (15.3%), and on the contrary SPT was positive with MLD and negative with SL in only 13 tests (1%). In conclusion, we claim that SPT using SL shows a higher degree of sensitivity and reproducibility.**

Skin prick testing (SPT) is widely used in the assessment of allergic disorders. For many years, SPT with extracts of inhalant allergens eliciting immediate wheal and flare reactions has been the preferred method of demonstrating IgE sensitization to allergens that might trigger allergic rhinitis or asthma. In routine practice, allergists generally use SPT because it is rapid, simple, convenient, relatively painless, cost effective and relatively safe with little risk of anaphylaxis.[1] Prick tests can be performed in a variety of ways, and these variations greatly influence testing results. It has been shown that the size of the response and the reproducibility of the method are related to the penetration depth. The lancets have been designed to limit skin penetration to 1 mm. This allegedly overcomes the variation in the responses that can arise from differing depths of allergen penetration.[2,3] Although the lancet is designed to give a standardized prick depth, it is possible that differences in skin responses could also be due to a difference in the pressure applied to the lancet.[4] Different SPT techniques are widely used. Factors including convenience, reliability, reproducibility and patient acceptance influence the selection of any particular SPT technique. The aim of this study was to compare the results of SPT using a multiple lancet device (MLD) with the results of a single lancet (SL).

MATERIALS AND METHODS

Fifty patients, 32 female and 18 male, with allergic rhinitis were

From the Department of Clinical Immunology and Rheumatology, Ankara University Faculty of Medicine, Ankara, Turkey.
Correspondence: Aşkın Ateş

included in the study. The mean age was 36.6 ± 8.7 years. Thirty-six patients had received specific immunotherapy (SIT) previously. Fourteen of the patients were diagnosed recently. No patient had received any medication affecting the skin response for at least 72 hours prior to the test. The study protocol was approved by the Committee on Medical Ethics of the Ankara University Faculty of Medicine, and written informed consent was obtained from individual subjects.

The SPT was performed by the same experienced nurse. The test sites were placed at intervals of 20 mm on the volar side of the forearms in a straight line from approximately 5 cm below the elbow flexure to about 10 cm above the wrist. For liquid extracts (ALK, 1/100 w/v), a drop of the extract was placed on the test site of the skin, and a sterile disposable single lancet (SL) with a point length of 1 mm was directed through the drop with moderate pressure at an angle of 90° to the skin, and the drops were wiped off thereafter. The lancets used were ALK-lancets. After one week SPT was repeated using a multiple lancet device (MLD). The Quintest multi-test device (Bayer Corporation Spokone, WA) has five tiny steel lancets with surrounding plastic guards and a minimum separation of 30 mm. After the test liquid is applied to the points of each head, the multi-test device is pressed into the skin, depositing a uniform amount of material into the epidermis by multiple puncture. The patients were tested with a panel containing 19 specific allergens, histamine as positive control and glycerol-saline as negative control. The nineteen allergens were: grass pollen (*Avena elatior* [205], *Dactylis glomerata* [214], *Lolium prenne* [223], *Poa pratensis* [228], *Secale cereale* [231], *Triticum savitum* [223], *Zea mays* [235] and mixed grass pollen [299]), tree pollen (*Artemisia vulgaris* [312], *Chenopodium album* [322], and *Plantago lanceolata* [342]), house dust mites [*Dermatophagoides pteronyssinus* [503], and *Dermatophagoides farinae* [504]), weed pollen (*Corylus avellana* [113], *Alnus glutinosa* [106], *Betula verrucesa* [108], mixed weed pollen [197], *Olea europa* [154], and *Quercus robur* [138]). The allergenic potency of the extracts was expressed as their concentration (w/v). The allergen extracts used were Soluprick SQ (Allergologisk Laboratorium A/S, Denmark) (ALK). The skin responses were recorded after 15 minutes by measuring the diameters of the wheal and the erythema. A positive skin prick test was defined as a wheal diameter of ≥ 3 mm.

Results were given as mean ± standard deviation. The means were compared using Mann-Whitney U test. A $p < 0.05$ was considered statistically significant.

RESULTS

The mean diameter of the erythema responding to histamine (positive control) using SL was significantly greater than that obtained using MLD (22.3 ± 3.4 and 16.2 ± 6.4 mm, respectively; $p < 0.001$). The SL also produced a significantly larger mean wheal diameter for histamine compared to the MLD (5.6 ± 1.0 and 4.2 ± 1.2 mm, respectively; $p < 0.001$). A positive skin test to

Table 1 A comparison between the skin erythema and wheal responses to different grass pollen allergen extracts obtained using single lancet and the multiple lancet device

	Erythema (mm)			Wheal (mm)		
	Single lancet	Multiple lancet device	*p*	Single lancet	Multiple lancet device	*p*
205	20.6 ± 5.7	7.9 ± 8.9	< 0.001	5.2 ± 1.4	2.6 ± 2.5	< 0.001
214	19.5 ± 6.1	10.4 ± 9.5	< 0.001	5.1 ± 1.9	2.9 ± 2.2	< 0.001
223	19.3 ± 5.9	10.1 ± 10.2	< 0.001	5.0 ± 1.8	2.8 ± 2.6	< 0.001
228	19.5 ± 6.1	7.9 ± 9.9	< 0.001	5.8 ± 2.5	1.9 ± 2.3	< 0.001
231	20.7 ± 5.9	10.2 ± 9.1	< 0.001	5.5 ± 2.7	3.1 ± 2.5	< 0.001
233	18.2 ± 7.2	10.0 ± 9.4	< 0.001	4.4 ± 1.9	2.7 ± 2.4	< 0.001
235	17.0 ± 8.1	8.0 ± 8.6	< 0.001	3.1 ± 1.3	2.0 ± 1.8	< 0.01
299	19.7 ± 5.9	8.8 ± 9.5	< 0.001	5.0 ± 1.9	3.0 ± 3.1	< 0.001
All	19.3 ± 6.4	9.2 ± 9.3	< 0.001	4.9 ± 2.1	2.6 ± 2.5	< 0.001

glycerol-saline (negative control) was observed in only one patient.

The diameters of the wheal and the erythema as a reaction to different grass pollen allergen extracts are shown in Table 1. The skin responses for each grass pollen allergen and all grass pollen allergens in the 307 tests obtained using SL were significantly larger than those obtained using the MLD.

The skin wheal and flare responses for tree pollen allergen extracts obtained by SL were generally significantly larger than those using MLD (Table 2). Although the skin responses were higher for the SL technique compared to MLD, the differences were not statistically significant for *Corylus avellana* (113).

The diameters of the wheal and the erythema as a reaction to weed pollen allergen extracts are shown in Table 3. Although the skin responses were higher for the SL technique compared to the MLD, the differences were not statistically significant for *Artemisia vulgaris* (312).

The skin responses to house dust mite allergen extracts obtained by SL were found to be significantly larger than those obtained by MLD (Table 4).

A similar trend was observed in both recently diagnosed patients and those who had previously received SIT (Tables 5 and 6). The skin responses obtained by both techniques were generally higher in the newly diagnosed patients than in the patients who had received SIT. The comparison between the MLD and the SL methods revealed that SPT were positive with SL and negative with MLD in 176 tests (15.3%) but positive with MLD and negative with SL in only 13 tests (1%).

DISCUSSION

The skin prick test has been the basic tool in the diagnosis of allergic diseases and for SIT treated patients with allergic rhinitis. Skin tests are based on the principle that an antigen presented to tissue mast

Table 2 A comparison between the skin erythema and wheal responses to different tree pollen allergen extracts obtained using the single lancet and the multiple lancet device

	Erythema (mm)			Wheal (mm)		
	Single lancet	Multiple lancet device	*p*	Single lancet	Multiple lancet device	*p*
106	15.4 ± 6.7	2.1 ± 4.2	< 0.01	3.3 ± 1.8	0.5 ± 1.0	< 0.01
108	18.0 ± 8.5	6.0 ± 7.5	< 0.05	4.5 ± 2.1	2.1 ± 2.9	< 0.05
113	10.6 ± 10.6	7.8 ± 10.3	NS	2.7 ± 3.5	2.5 ± 2.6	NS
197	13.0 ± 5.2	2.1 ± 4.2	< 0.05	3.9 ± 3.1	1.8 ± 2.1	NS
154	11.3 ± 7.0	1.9 ± 3.1	< 0.05	2.2 ± 1.0	0.8 ± 1.1	NS
All	11.7 ± 7.9	4.3 ± 7.2	<0.01	2.8 ± 2.3	1.6 ± 1.9	<0.05

NS, non-significant difference

Table 3 A comparison between the skin erythema and wheal responses to different weed pollen allergen extracts obtained using the single lancet and multiple lancet device

	Erythema (mm)			Wheal (mm)		
	Single lancet	Multiple lancet device	*p*	Single lancet	Multiple lancet device	*p*
312	11.9 ± 10.7	9.0 ± 11.3	NS	2.3 ± 1.9	2.2 ± 2.8	NS
322	12.5 ± 9.1	6.0 ± 6.6	< 0.05	2.2 ± 1.2	1.4 ± 1.5	NS
342	15.3 ± 7.4	2.6 ± 5.3	< 0.001	3.2 ± 1.2	0.5 ± 1.3	< 0.001
All	13.2 ± 9.1	5.0 ± 7.2	= 0.001	2.5 ± 1.5	1.2 ± 1.9	< 0.01

NS, non-significant difference

Table 4 A comparison between the skin erythema and wheal responses to different house dust mite extracts obtained using the single lancet and multiple lancet device

	Erythema (mm)			Wheal (mm)		
	Single lancet	Multiple lancet device	*p*	Single lancet	Multiple lancet device	*p*
503	12.3 ± 7.1	6.4 ± 8.4	< 0.05	3.9 ± 1.3	1.9 ± 2.1	< 0.05
504	11.7 ± 7.1	6.9 ± 7.1	< 0.05	2.9 ± 1.2	1.7 ± 1.6	NS
All	12.4 ± 7.5	7.6 ± 7.8	< 0.01	3.4 ± 1.5	2.0 ± 1.8	< 0.01

NS, non-significant difference

Table 5 A comparison between the skin responses to all tested allergen extracts obtained using the single lancet and the multiple lancet device in newly diagnosed patients

	Erythema (mm)			Wheal (mm)		
	Single lancet	Multiple lancet device	*p*	Single lancet	Multiple lancet device	*p*
106	14.5 ± 3.5	1.2 ± 2.0	< 0.05	2.1 ± 0.3	0.3 ± 1.0	NS
108	12.0 ± 9.7	2.0 ± 3.2	< 0.05	3.0 ± 2.4	0.8 ± 1.4	< 0.05
113	9.0 ± 10.5	6.7 ± 10.6	NS	2.0 ± 2.8	1.3 ± 1.5	NS
154	11.3 ± 8.6	2.1 ± 3.7	< 0.01	2.0 ± 1.2	0.8 ± 1.1	NS
197	9.0 ± 4.2	1.2 ± 1.8	< 0.05	2.6 ± 0.7	1.5 ± 2.1	NS
205	19.3 ± 6.4	6.3 ± 8.6	< 0.001	4.8 ± 1.3	2.0 ± 2.1	< 0.001
214	18.4 ± 6.4	8.6 ± 9.5	< 0.001	4.6 ± 1.8	2.4 ± 2.2	< 0.001
223	18.2 ± 6.1	7.6 ± 9.7	< 0.001	4.7 ± 1.9	1.9 ± 2.1	= 0.001
228	18.6 ± 6.2	6.9 ± 9.7	< 0.001	4.9 ± 2.0	1.5 ± 1.9	< 0.001
231	19.7 ± 6.6	10.0 ± 9.4	< 0.001	4.6 ± 2.1	3.2 ± 2.6	< 0.05
233	16.3 ± 7.8	10.1 ± 9.5	< 0.05	3.9 ± 1.7	2.5 ± 2.1	< 0.01
235	15.3 ± 8.5	8.1 ± 9.0	< 0.01	2.9 ± 1.3	1.9 ± 1.8	< 0.05
299	19.1 ± 6.5	6.0 ± 8.8	< 0.001	4.9 ± 2.0	1.9 ± 2.1	< 0.001
312	11.6 ± 10.6	8.4 ± 9.5	NS	2.8 ± 2.7	2.1 ± 2.1	NS
322	14.7 ± 9.5	7.9 ± 6.9	NS	2.3 ± 1.2	1.7 ± 1.6	NS
342	16.8 ± 7.4	2.6 ± 5.7	= 0.001	3.4 ± 1.3	0.7 ± 1.4	< 0.01
503	11.8 ± 7.7	5.6 ± 8.6	NS	3.9 ± 1.1	1.4 ± 1.7	< 0.01
504	10.6 ± 7.3	7.4 ± 7.4	NS	2.7 ± 1.2	1.8 ± 1.6	NS

NS, non-significant difference

cells cross-links surface-bound IgE, resulting in the release of mediators and the production of a measurable wheal and flare.[5] As reported in our study and previous studies, the problem is that a variation in the response can arise from the usage of different SPT techniques.[6,7] It has been shown that the size of the response and the reproducibility of the method are related to the penetration depth.[7] In our study we found that the size of the reactions to all specific allergens by SL was higher than that by MLD. This trend was not influenced by a previous SIT. The variations in the size of the responses between the 2 methods could not be related to the penetration depth in our study because the lancets in both techniques had the same prick depth (a point length of 1 mm). It is possible though that the difference in the skin response could also have been due to a difference in the pressure applied to the lancet during SPT or to a difference in the duration of the allergen exposure during SPT.

All lancets in the MLD protrude from the block by the same length, and the face of the block prevents undue penetration of the skin. Skin tests are thus performed with a similar penetration, reducing

Table 6 A comparison between the skin responses to all tested allergen extracts obtained using a single lancet and the multiple lancet device in patients who had received specific immunotherapy

	Erythema (mm)			Wheal (mm)		
	Single lancet	Multiple lancet device	*p*	Single lancet	Multiple lancet device	*p*
106	16.3 ± 10.9	4.3 ± 6.0	< 0.05	4.5 ± 2.1	0.7 ± 1.4	< 0.05
108	24.0 ± 5.8	10.0 ± 9.3	< 0.05	6.0 ± 4.2	3.2 ± 4.0	NS
113	17.0 ± 9.5	12.0 ± 11.1	NS	7.5 ± 6.3	3.2 ± 2.9	< 0.05
154	11.3 ± 4.9	2.4 ± 2.4	< 0.05	2.4 ± 0.5	0.8 ± 1.1	NS
197	17.0 ± 4.2	3.3 ± 5.0	< 0.05	5.3 ± 4.5	2.1 ± 2.9	< 0.05
205	23.5 ± 1.9	11.2 ± 9.2	= 0.001	6.2 ± 1.3	3.8 ± 2.8	< 0.05
214	21.7 ± 2.8	14.1 ± 8.6	< 0.05	6.0 ± 1.8	3.9 ± 2.0	< 0.05
223	22.0 ± 4.0	15.5 ± 9.5	NS	5.8 ± 1.2	4.6 ± 2.8	NS
228	20.6 ± 5.9	10.0 ± 10.4	< 0.01	7.1 ± 2.9	2.8 ± 2.9	< 0.01
231	22.8 ± 2.7	10.6 ± 8.8	= 0.001	7.2 ± 3.0	2.9 ± 2.3	= 0.001
233	21.8 ± 3.4	9.8 ± 9.5	= 0.001	5.2 ± 2.0	3.9 ± 2.9	< 0.05
235	20.0 ± 6.0	7.8 ± 8.0	< 0.01	3.6 ± 1.0	2.1 ± 1.9	< 0.05
299	21.5 ± 4.2	14.4 ± 8.7	< 0.05	5.3 ± 1.6	5.2 ± 3.5	NS
312	24.0 ± 8.8	3.2 ± 3.4	< 0.01	3.2 ± 1.5	0.8 ± 1.2	< 0.05
322	7.9 ± 7.0	2.1 ± 4.2	< 0.05	1.8 ± 1.3	0.8 ± 1.5	NS
342	10.5 ± 5.8	2.8 ± 4.9	< 0.01	2.4 ± 0.5	0.7 ± 1.0	NS
503	14.5 ± 3.5	10.0 ± 9.9	NS	4.1 ± 2.7	4.0 ± 2.8	NS
504	17.0 ± 7.2	4.3 ± 6.0	< 0.01	4.2 ± 2.4	1.1 ± 1.4	< 0.05

NS, non-significant difference

false negative responses to errors in the technique. Nevertheless, there have been some negative reports chiefly concerning issues of sensitivity and reproducibility. Previously, Aas[8] concluded that multi-test was less reproducible than SL. He found the size of the histamine reactions by multi-test to be smaller than that induced by single prick. Later, several investigators showed that the Quintest multi test device produced smaller wheals than the SL device.[9-11] Rhodius *et al.*[11] also showed that in their population almost 25% of the subjects would have been misclassified using the Quintest applying Bayer allergens. Similar to the study of Rhodius *et al.*,[11] in our study, in assessing the responses to all specific allergens in 1,150 tests, the frequency of positive reactions to SPT using SL, while no SPT reactions using the MLD could be observed, was 15.3% (176/1,150 tests). On the other hand, the frequency of positive reactions to SPT using the MLD were only 1% (13/1,150 tests) when SL did not elicit any reaction. These findings suggest that the Quintest may both constrain the size of the allergic reactions as well as be responsible for false-negative reactions. Phagoo *et al.*[4] suggested that in any single prick a critical pressure between moderate and hard was found to be necessary to minimize the risk of false negative results. In our study, the skin prick tests were performed by the same experienced nurse in order to minimize the variation in the responses that can arise from performing SPT with varying pressures. As a result we claimed that SPT using SL showed a higher degree of sensitivity and reproducibility. In our study, the high degree of negative results using MLD compared to using SL could have arisen from lower skin responses to SPT using MLD. This could be due to the amount of allergen deposited at the site of penetration, which might have been lower for the Quintest than for the SL device. Or it might have been that the outer plastic rim of the Quintest, by producing a small indentation in the skin, was actually constraining the size of the subsequent wheal.

In conclusion, different skin prick test devices offer different potential advantages to the user. The use of the MLD overcomes the difficulty of a standardized pressure applied to the lancet and is rapid, convenient and humane for use with young children and also requires little allergen extracts. Nevertheless, the lower degree of sensitivity and reproducibility are the disadvantages

of this method compared to the SL.

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