

Cutaneous hypersensitivity to *Malassezia sympodialis* and dust mite in adult atopic dermatitis with a textile pattern

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Atopic dermatitis (AD) patients with predominantly head and neck involvement react to patch tests of the yeast *Malassezia sympodialis* (*Ms*). Protein patch testing methods and interpretation are controversial, but subgroups of AD patients may have unique triggers for disease activity. The aim of the study was to identify clinical characteristics of patients who are patch test-positive to *Dermatophagoides farinae/pteronysinus* (*Df*) and *Ms* and characterize cutaneous cytokine profiles of the atopy patch tests (APTs). 25 AD patients and 27 control dermatitis patients were patch tested with *Ms* and *Df*. Qualitative analysis of Th-1 and Th-2 cytokines by RT-PCR mRNA was obtained from positive APTs. Atopic dermatitis patients with a textile pattern or head and neck involvement demonstrated more positive APTs to *Ms* than control patients. Early positive APTs (<6 hr) did not exhibit a Th-1 type cytokine profile. The subgroup of adult AD patients with head, neck and upper torso pattern of dermatitis seems most likely to react to *Ms* (and *Df*). The immune mechanism of protein patch tests includes a Th-1 cell-mediated component after 6 hr or more.

Key words: atopic dermatitis; atopy patch test; dust mite; protein contact dermatitis; textile-pattern dermatitis. © 2006 The Authors. Journal compilation © 2006 Blackwell Munksgaard.

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Atopic dermatitis (AD) is somewhat protective against sensitization to chemical allergens (1), but AD patients are much more likely to suffer from protein contact dermatitis to latex than people without AD (2). The role of protein contact allergens in causing eczema is controversial (3) as is the utility of atopy patch tests (APTs) in diagnosing hypersensitivity.

Atopic dermatitis patients have a high rate of positive prick tests to protein allergens, but this is often used as a diagnostic criterion rather than as a treatment with suggested avoidance of such allergens. Positive APTs to environmental proteins likewise have been considered by many to be irrelevant to diagnosis and treatment. Alternatively, others have suggested that APT positivity to environmental proteins represents

an irritant response. However, there is emerging data that subgroups of AD patients have unique triggers for disease activity (4).

Some evidence suggests that meticulous avoidance of antigens associated with positive APTs may improve the course of AD (5, 6). Systemic antiyeast therapy has been shown to benefit some patients with AD (7). This may be due to reduction of allergenic yeasts such as *Malassezia sympodialis* (*Ms*), which colonizes the scalp, face and upper torso (8). Atopic dermatitis patients have been shown to have a high incidence of positive APTs to *Ms*, which are not present in non-atopics or in patients with seborrheic dermatitis or tinea versicolor (9). Dust mite (*Dermatophagoides pteronyssinus/farinae*) (*Df*) often provokes positive APTs in AD patients, and avoidance has proven to be clinically beneficial in some studies (5, 6).

Atopy patch tests may be an appropriate method to diagnose clinically relevant protein

contact dermatitis. Protein contact dermatitis was first described by Hjorth and Roed-Petersen (10) with reference to food proteins. Protein contact dermatitis has both urticarial (immediate, type 1) and eczematous features (delayed type 4). In particular, the reaction to latex has been well characterized (11). The clinical presentation, morphology and behaviour of the APT sites of protein contact dermatitis differ from the delayed type eczematous reaction of conventional allergic contact dermatitis to chemicals such as fragrance or metals.

Atopy patch tests may be positive as early as 1 hr after application, with early reactions generally composed of small confluent papules rather than the urticarial wheal seen with patch tests to chemicals, such as benzyl alcohol, that cause non-immunologic urticaria. Strong late reactions have a multipapular morphology, rather than a single nodule or bullae as seen in conventional chemical patch tests. For this reason, the APT is best graded with the European Task Force on AD APT grading scale (12) rather than the International Contact Dermatitis Research Group scale that is traditionally used for chemical patch tests.

Most chemical sensitizers are also irritants, and some authors have suggested that proteins such as dust mite (*Df*) which contain proteolytic enzymes also act as irritants in APTs (13). Most pathogenic fungi and *Candida albicans* (*Ca*) also secrete proteases that assist in adherence and penetration of tissue and that interact with the host immune system (14). Earlier studies have reported Th-0 to Th-2 helper T-cell shift in early positive APTs followed by a later change to a Th-1 profile (15). This pattern may represent an allergic rather than an irritant response. The optimal antigen concentrations to minimize irritation and to prevent active sensitization for atopy patch testing are still unknown.

The study presented here examines APTs to dust mite and commensal skin yeast at various concentrations in patients that had been previously diagnosed with AD and compared them to patients with dermatitis but without a history of childhood dermatitis who were undergoing evaluation in our patch test clinic. The APTs were observed for positive reactions at 1 hr and 6 hr (early readings) and at 48–72 hr (late readings), and the results were compared with RAST results (specific IgE) for each allergen tested. The clinical pattern of dermatitis was recorded and examined for correlation with APT results. Finally, cytokine profiles were obtained from skin biopsies of both early and late positive APTs to assist in differentiating allergic from irritant reactions.

Methods

Subjects

25 patients with a history of AD were recruited within a university-based clinical practice and/or through campus-wide advertising. The mean age of the participants was 45. All patients satisfied Hanifin-Rajka criteria (16). Patients with predominant involvement of the face and scalp or accentuation of rash in the anterior and posterior axillary line but sparing the axillary vault, dermatitis of the upper back just under the neck, and dermatitis under snug garments were considered to have a textile/head/neck pattern. Patients with predominantly hand and foot or generalized involvement were classified as 'other'. 13 patients had previously been treated with immunomodulating topicals such as pimecrolimus and/or tacrolimus. All patients had been treated with topical and/or systemic corticosteroid therapy. Patients discontinued all systemic treatments and topical treatments on the test areas 2 weeks prior to testing. An exception was made for 1 patient, who was tested on 10 mg of prednisone because of a history of erythroderma when prednisone treatment was discontinued. Patient profiles of atopic dermatitis patients are shown (Table 1).

27 patients with the mean age of 50 (ages 16–84) undergoing evaluation for dermatitis in our patch test clinic were tested as non-atopic dermatitis controls. These patients did not have a history of childhood flexural dermatitis, although many gave a history of hayfever or chronic sinusitis, and several ultimately carried a working diagnosis of atopic related dermatitis. These patients underwent APTs for *Ms*, *Ca*, and *Df* at the concentrations and times indicated below. The control group patch test reading schedule differed from the AD study subject's schedule to accommodate concurrent reading of conventional patch test in the clinic setting.

The study was approved by the University Hospitals of Cleveland, Institutional Review Board (UHC IRB). Each patient provided informed consent prior to participation in these studies.

Allergens

Malassezia sympodialis. *Ms* was obtained from the American Type Culture Collection (ATCC) 42132. ATCC 42132 was grown on agar with 1110 *Pityrosporum* medium II containing neopeptone (10 g/l), bacto-agar (18 g/l), glucose (40 g/l), yeast extract (0.1 g/l), glycerol monostearate (2.5 g/l), Tween-80 (0.2%)

Table 1. Atopic dermatitis patients by clinical pattern with atopy status, RAST and atopy patch test results

Age	Gender	Hx of respiratory atopy	RAST Df	RAST Ca	RAST Po	APT Df	APT Ca	APT Ms	Clinical pattern
74	Male	Rhinitis	0	0	0	1+	–	–	Textile
77	Female	Rhinitis	III	I	0	4+	–	3+	Textile
36	Female	None	II	0	0	–	–	–	Textile
56	Female	Rhinitis	0	0	0	3+	–	–	Textile
39	Male	None	II	0	0	2+ early only	–	2+ early	Textile
53	Female	None	0	0	0	4+	–	3+	Textile
67	Male	None	II	0	0	–	–	–	Textile
44	Male	Rhinitis	III	II	0	3+ early	2+	–	Head/neck
18	Female	None	0	0	0	4+	–	–	Head/neck (scalp only)
27	Female	Rhinitis	IV	II	II	–	–	–	Head/neck
46	Male	Rhinitis	III	0	0	1+	–	–	Head/neck
31	Male	None	0	0	0	–	–	–	Head/neck
11	Female	None	II	I	0	–	–	4+	Head/neck
69	Male	None	0	0	0	–	–	–	Head/neck
51	Male	Rhinitis	IV	IV	0	3+	–	3+	Head/neck
60	Female	Rhinitis	0	0	0	3+	–	–	Head/neck
56	Male	Asthma, rhinitis	V	III	III	2+	–	2+ early	Head/neck
76	Female	None	0	0	0	–	–	–	Head/neck
23	Female	Rhinitis	0	I	II	–	–	–	Extremities
23	Female	Asthma, rhinitis	ND	ND	ND	3+	–	–	Hand/foot
2	Male	None	0	0	0	–	–	–	Generalized
39	Female	Asthma	0	0	0	–	–	–	Hands, eyelids, torso
16	Female	Asthma, rhinitis	0	0	0	–	–	–	Hands, torso
53	Female	Asthma	0	0	0	– (but 2+ late rxn day 7)	–	–	Arms, genitals
41	Female	Asthma	0	0	0	4+	–	–	Dyshidrotic

APT, atopy patch test; Ca, *Candida albicans*; Df, *Dermatophagoides farinae/pteronysinus*; Ms, *Malassezia sympodialis*; Po, *Pityrosporum orbiculare*. RAST: class 0 = <0.35; class I = 0.35–0.7; class II = 0.7–3.5; class III = 3.5–17.5; class IV = 17.5–50; class V = 50–100.

(DIFCO Sparks, MD) and olive Oil (2%). The pH was adjusted to 5.6 prior to sterilization by autoclave. Ms was grown at 37°C for 3–5 days before colony removal. Speciation was performed by the Center for Medical Mycology at University Hospitals of Cleveland (UHC). Colonies were washed 3 times in phosphate-buffered saline. The yeasts were rendered non-viable by exposure to UV light in a Stratagene UV-cross linker (Spectronics Corporation, Westbury, NY, USA) at 120 000 µJ/cm² for 20 min. Viability was assessed by replating an aliquot of the yeast onto Sabouraud dextrose agar (DIFCO Laboratories, Detroit, MI, USA) plates, followed by incubation at 37°C for 3 days. These organisms were then collected by centrifugation and dehydrated by Speed Vac (Labconco, Kansas City, MO, USA) vacuum centrifugation. Dry weights were determined and suspensions were made in petrolatum (pet.) for the following concentrations: 0.4%, 4%, 40% and 80%. Atopic dermatitis subjects were tested to each of these concentrations and control patients to 40% Ms only.

Candida albicans. Ca (clinical isolate SC5314) was obtained from the Center for Medical

Mycology in the Department of Dermatology at University Hospitals of Cleveland. Ca was grown in Sabouraud dextrose broth media. Whole cells were obtained from 3-day cultures. The yeast cell suspensions were treated as described for Ms. Dried yeast was resuspended in white pet. at 0.4%, 4% and 40%. Atopic dermatitis patients were tested to each of these concentrations; control subjects were tested to 4% Ca only.

Dermatophagoides farinae/pteronysinus. 20% Df was obtained from Chemotechnique (Malmö, Sweden) as a Df mix. Df mix was diluted in white pet. at 0.1%, 1% and 10%. Atopic dermatitis patients were tested to each of these concentrations; controls were tested to 10% Df only.

Atopy patch tests

The above antigen mixtures as well as 3% sodium lauryl sulphate (SLS) in saline as an irritant control were placed onto 5 mm Finn chambers[®] and applied to intact and, in the first 8 subjects only, scarified skin on the upper back. Agarose agar was used as a negative control for the AD patients who were undergoing only the APTs. pet. was used as a negative control in the control dermatitis patients

undergoing conventional patch testing as well as the APTs. If scarification was performed in addition to testing on intact skin, the skin was scarified with a 30-gauge needle in a 4 perpendicular line configuration. Application sites were examined for erythema and papule formation at 1 hr, 6 hr and 48–72 hr postapplication. Control subjects were examined at 72 hr and 7 days after application. Subjects' skin was rated using the APT Reaction Grading Key as defined by the ETFAD: (–) no reaction, (?) erythema, (+) erythema and infiltration, (++) erythema and few papules (up to 3), (+++) erythema and papules (from 4 to many), (++++) erythema and many papules or spreading papules and (+++++) erythema and vesicles (12).

RNA extraction and cDNA synthesis

A total of 26 punch biopsies (4 mm in diameter) were obtained from 13 APT positive AD patients who provided informed consent. The biopsies were immediately flash frozen in liquid nitrogen and cryopreserved at -70°C until RNA extraction was performed. The tissue was pulverized using a Mikro-Dismembrator S (B. Braun Biotech International, Allentown, PA, USA), which pulverized the frozen tissue to powder. The powdered tissue was then resuspended in RNA extraction buffer and processed according to the manufacturer's protocol (Qiagen, Hilden, Germany). RNA was eluted in 40 μl of Rnase-free water (Clontech, Mountain View, CA, USA), and the RNA content was determined spectrophotometrically. 0.5 μg of RNA underwent reverse transcription in a total volume of 20 μl to generate cDNA for subsequent polymerase chain reaction (PCR) analysis.

PCR was performed using specific forward and reverse primers (Bio-synthesis, Lewisville, TX, USA) for interleukin (IL)-4, IL-6, IL-8, IL-10, IL-12p35, IL-12p40 and interferon (IFN)- γ . β -actin amplification was performed for normalization of the PCR reaction. Positive controls for the PCR reactions were performed using plasmid-containing inserts for the genes of interest (InvivoGen, San Diego, CA, USA).

Immunoglobulin E measurements

Serum samples were sent to The Johns Hopkins University of Dermatology, Allergy and Clinical Immunology (DACI) Reference Laboratory in Maryland. Samples were measured for *Df*, *Ca* and *Pityrosporum orbiculare* (as proxy for *Ms*) using the Pharmacia CAP SystemTM (Pharmacia Diagnostics AB, Portage, MI, USA).

Results

Clinical patterns of dermatitis

Many patients with a textile pattern of atopic dermatitis also had a head and neck involvement, and the 18 patients in these groups were combined for data analysis. 7 patients were classified as 'other' pattern.

Temporal patterns of APT response

Early (1–6 hr positive APT) responders. 3 of 25 AD patients were observed to have early (1–6 hr) positive APT to either *Ms* and/or *Df*. 6 hr after test placement, 1 patient was APT positive to both *Ms* and *Df*, while 1 patient each was positive to *Df* only and *Ms* only.

Late (48–72 hr positive APT) responders. 15 patients were late responders with a total of 20 APT-positive sites. 3 were also included in the early responder group and exhibited early positive APTs to *Df* or *Ms*. 6 of the 15 late-responding patients were APT positive to *Ms*, and 1 patient was APT positive to *Ca*. 3% SLS in saline was used as a control for irritancy on a subset of 10 patients, with only 1 experiencing a positive reaction. The appearance of the SLS reaction site was different from the APT reaction sites. SLS reactions were characterized by diffuse erythema and a glazed appearance, consistent with irritant morphology, whereas the APT sites demonstrated a papular morphology.

The majority of positive APT reactions and all of the *Ms* reactions occurred in patients with head and neck or textile pattern dermatitis. All of the early (less than 6 hr) reactions also occurred in this group. None of the dermatitis patients who served as controls reacted to *Ms* ($P \leq 0.05$) (Table 2). The proportion of controls reacting to *Df* was not significantly different than the percentage of AD patients responding (37% versus 56%, respectively), while the number of (control) subjects reacting to *Ca* exceeded the AD patients (Table 2).

Reproducibility of patch tests

1 patient (positive for both *Ca* late and *Df* early) returned for repeat testing. This patient had reproducible APT results for the allergens examined when retested 4 months later (Fig. 1). The characteristic APT response of papular morphology is shown in this patient.

Table 2. Atopic dermatitis (AD) versus control atopy patch test (APT) results

	AD (n = 25)	Dermatitis patients in the patch test clinic (controls) (n = 27)	P-value*
Patients with $\geq 1+$ reaction to <i>Df</i> 10%	14 (56%)	10 (37%)	0.17 (C)
Patients positive to <i>Ca</i> 0.4%	1 (4%)	3 (11%)	0.61 (F)
Patients positive to <i>Ms</i> 40%	6 (24%)	0 (0%)	0.0087 (F)

Ca, *Candida albicans*; *Df*, *Dermatophagoides farinae/pteronysinus*; *Ms*, *Malassezia sympodialis*. AD patients are more likely than controls to react to APT with *Ms*.

*C = Chi-square test; F = Fisher's exact test.

PCR results

mRNA for IFN- γ was not detected from 5 punch biopsies obtained from early responders (n = 3). mRNA for IL-4 was undetectable in all of the patients tested. However, greater than 50% (11/19) of the biopsies taken from the 12 consenting late responders had detectable mRNA for IFN- γ . IL-8 cytokine mRNA was detected in 2 out of 5 early positive APTs and in 5 out of the 19 late positive APTs. IL-12p35 cytokine mRNA was detected in 1 out of 5 APTs in the early responders and in 8 out of 19 APTs in the late responders. 1 biopsy was obtained from a normal volunteer without prior patch testing to compare cytokine profile. This normal biopsy was positive for IL-12p35 and β -actin only. IL12p40 cytokine mRNA was detected in 4 out of 5 APTs in the early responders and in 15 out of 19 APTs in the late responders. All samples were negative for mRNA detection of IL-6 and IL-10 (Table 3).

RAST correlation with APT

Serum RAST tests did not show significant correlation with APT results. There was a trend towards better correlation between RAST and early APT responding patients than with RAST and late APT-responding patients in response to both *Df* and *Ms* (Table 4).



Fig. 1. Typical positive cutaneous reaction observed following Atopy patch test for one hour. An erythematous and papular response to a 20% dust mite preparation in petrolatum is shown here. The arrow indicates positive APT area with characteristic erythema and papular responses.

Discussion

Our AD patients (n = 25) demonstrated an approximate 50% response rate of positive APT reactions to dust mite, with a lower percentage (24%) of APT response to *Ms* and only 1 reaction to *Ca* (4%). Compared to non-atopic dermatitis control subjects, the AD patients had significantly more APT reactions to *Ms* (Table 2). Most of these reactions were positive at our defined late time point (i.e. became positive more than 6 hr after application). Although the data showing lower frequency of dust mite reactivity results in non-atopics as compared to AD subjects were not statistically significant, there were proportionately more patients with APT-positive results in the AD group. This data also showed higher contact sensitivity to *Ca* in control subjects as compared to AD subjects, which may suggest that AD patients develop a specific anergy to *Ca* antigen (17).

In our clinical experience, textile pattern atopic dermatitis usually occurs in adults rather than adolescents or children and often occurs without a history of childhood eczema. Differential diagnosis of these patients includes allergic contact dermatitis to textile dyes and finishes which must be excluded with patch testing to an appropriate textile series.

Atopic dermatitis patients have previously been shown to have more dust mite in their clothing than normal patients, presumably due to

Table 3. Atopy patch test (APT) reactions exhibit detectable levels of interleukin (IL)-12 and interferon (IFN)- γ at 48–72 hr

48–72 hr*	IL-4	IL-8	IL-12p35	IL-12p40	IFN- γ
<i>Df</i>	0/12	2/12	4/12†	10/12	7/12
<i>Ms</i>	0/6	3/6	4/6	4/6	4/6

Df, *Dermatophagoides farinae/pteronysinus*; *Ms*, *Malassezia sympodialis*. All samples were negative for IL-4, IL-6 and IL-10. 19 biopsies were taken, and 1 of these 19 was APT positive for *Candida albicans*, which showed signal for IL-12p40 and β -actin only.

*Includes data for 1 patient who had positive APT at day 7.

†Data expressed as number of positive PCR results among patients that were biopsied following positive APT reactions (e.g. 3 out of 13 patients that were APT positive for *Df* and biopsies were PCR positive for IL-12p35).

Table 4. RAST correlation with APT (Early responders vs. Late responders)

	RAST +	RAST –	Fisher's exact <i>P</i> -value
<i>Df</i>			
Early APT +	2	0	0.16
Early APT –	8	14	
Late APT +	5	7	1.00*
Late APT –	5	7	
<i>Ca</i>			
Early APT +	0	0	1.00
Early APT –	7	17	
Late APT +	1	0	0.29
Late APT –	6	17	
Ms/Pit orb	RAST+ Pit orb	RAST– Pit orb	Fisher's exact <i>P</i> -value
Early APT + Ms	1	1	0.24
Early APT – Ms	2	20	
Late APT + Ms	1	5	1.00
Late APT – Ms	2	16	

*Chi square; APT, atopy patch test; *Ca*, *Candida albicans*; *Df*, *Dermatophagoides farinae/pteronyssinus*; *Ms*, *Malassezia sympodialis*; *Po*, *Pityrosporum orbiculare*.

excessive shed of scale with dust mites living on the human scale (18). Positive APTs to *Df* may indicate hypersensitivity to dust mite antigens trapped in the seams of the patient's clothing, which under conditions of friction, cause a localized flare of dermatitis recognized as the textile pattern. It is possible that APTs to *Ms* could be useful clinically to identify patients who would most benefit from systemic antiyeast therapy (19). However, there is controversy regarding the mechanism of these APT reactions.

No correlation was found between RAST and APT results in our study. Previously, AD subjects who are APT negative to *Ca* have been shown to have high RAST reactivity to *Ca*; this is thought to be due to replacement of Th1 type T cells to *Ca* antigen with Th2 type T cells in AD (17, 20). Similarly, in *Ms* prick test-positive subjects, peripheral blood mononuclear cell stimulation index correlated with APT response to *Ms* but not with antigen-specific IgE. In this study, Th-2 type cytokines, rather than type 1 cytokines, correlated best with stimulation index to *Ms* (21). Thus, cell-mediated immunity, rather than humoral response alone, appears to play an important role in *Ms* APT reactions.

Historically, proteins have been considered too large to penetrate the epidermis. Therefore prick testing, which bypasses the epidermis, has been preferred. However, it has been demonstrated that epidermal LC that bear Fc receptor-bound IgE molecules can bind to house dust allergens and mediate allergen presentation to T cells (22). Although some investigators feel that the skin should be scratched prior to allergen application

to facilitate penetration of these large molecules, we found no difference between reactions when allergens were applied to intact or scarified skin in 8 of the patients. Furthermore, others have reported that APT has higher clinical relevance than prick or RAST testing (23). Immediate/early APT positivity may be mediated by specific IgE bound to Langerhans' cells, and >48 hr (late) positivity testing may be a result of T-cell-mediated mechanisms.

Most known allergens are also irritants. The danger signal hypothesis speculates that cytokine release initiated by irritants is necessary for sensitization (24). Therefore, it is not surprising that dust mites should also be irritants as they contain protease in the Der p 1 fraction. This study used a commercial preparation of crude dust mite, which was expected to retain protease activity. We also expect that our crude preparations of whole yeasts would also contain proteases (14). Prior studies by various authors have shown Th-2 cytokines such as IL-4 in early APTs, a shift from Th-1 cytokines in older patch tests, and IFN- γ in irritant reactions (15, 25). Surprisingly, we were not able to demonstrate that APTs trigger IL-4 release at either the early or late sampling times. We hypothesize that this may have been due to the small quantity of RNA obtained from our biopsy samples, combined with a low copy number of message for IL-4. An alternative explanation for the lack of IL-4 and presence of IFN- γ in APTs that become positive at 48–72 hr is that these reactions are mediated by a Th-1 pathway analogous to conventional chemical allergens. Improved

sensitivity using approaches such as quantitative TaqMan PCR may be necessary to amplify less-abundant mRNA species.

Atopy patch tests to *Df* and *Ms* may delineate subgroups of patients who would benefit from dust mite avoidance or from treatment with systemic azoles. Previous studies have demonstrated improvement in some AD patients with avoidance of dust mite (5, 6, 26), and systemic antifungal treatments have been previously shown to help some AD patients (19), but these interventions have been administered empirically. Prick testing for *Ms* in head and neck pattern AD patients did not exclusively identify those who responded to systemic itraconazole (27).

Clinical improvement may be dependent on meticulous avoidance of protein allergens. This may require significant effort on the part of the patient and family. This is analogous to the need for strict avoidance of many chemical allergens (e.g. poison ivy), where even short exposures to minor quantities of antigen triggers long-lasting dermatitis. There is evidence that use of mattress covers alone to lower dust mite burden is insufficient to improve asthma in dust mite-sensitive subjects (28).

Conclusion

Atopy patch tests are associated with a significantly different time course and reactive skin morphology than patch tests to conventional chemical allergens. These effects are consistent with a differing immunological mechanism. On the basis of cytokine profiles, these do not appear to be irritant reactions. It is possible that systemic and topical antiyeast therapies would be most effective in patients with cutaneous hypersensitivity to yeast as demonstrated by a positive APT to *Ms*.

Atopic dermatitis patients have a significantly higher rate of response to crude *Ms* patch tests than other dermatitis patients. The subgroup of adult AD patients with head, neck and upper torso pattern of dermatitis seems most likely to react to *Ms*. Previously, this group has been described as head and neck pattern, and we emphasize that these patients may have predominant involvement of the upper torso including the posterior neck and anterior and posterior axillary lines, suggesting a textile contact dermatitis. These patients may be reacting to commensal organisms in trapped clothing at areas of maximal perspiration and friction.

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