2. Photosensitivity test (Chapter 13)

Various photosensitivity tests are conducted by examining the reaction to irradiation. Ultraviolet radiation is divided into ultraviolet A (UVA) (operative wavelength of 320 to 400 nm), ultraviolet B (UVB) (operative wavelength of 290 to 320 nm) and ultraviolet C (UVC) (operative wavelength of 100 to 290 nm). UVA, UVB and visible light are most frequently used.

1) Photo test

The degree of photosensitivity and suitable operative wavelength can be measured and determined by the amount of radiation that causes cutaneous reactions such as pigmentation and erythema. By testing the operative wavelength on patients, it is possible to know which particular radiation exposure should be eliminated.

The most widely conducted photo test is exposure to UVB irradiation in the minimal dose that causes erythema in 24 hours (minimal erythema dose; MED). The average dose for ethnic Japanese is 60 to 100 mJ/cm² (Fig. 5.5). When the MED is low, involvement of a photosensitive disease is suspected.

Diseases of photosensitivity to UVA are rare, occurring for example in some cases of chronic actinic dermatitis. Pigmentation (suntan) is caused by UVA exposure; it is called the minimal response dose (MRD), in contrast to the MED. The normal MRD for ethnic Japanese is 5 to 15 J/cm². The result is determined 48 hours after irradiation.

Chronic actinic dermatitis and some cases of porphyria cutanea tarda are diseases in which there is sensitivity to visual light. There is no standard technique for measuring MRD for photosensitive diseases; they are generally observed in the cutaneous reaction induced by exposure to slide projector light for 15 to 20 minutes.

A photo-provocation test of exposure to 2 to 3 MED for 3 consecutive days may be performed in the case of photosensitive diseases to observe the reaction.

2) Photo-patch test

The photo-patch test is conducted to examine the influence of rays when a chemical substance is placed on the skin. Twenty-four to 48 hours after a material that is suspected of causing photosensitive disease is pasted on the skin, the site is exposed to UV rays. If reddening or swelling occurs within 24 hours, the test is considered to be positive for such disease.

3) Photo-drug test

The influence of radiation in the presence of a chemical substance can also be examined by photo-drug test. A drug that is
suspected of causing a photosensitive disease is taken orally instead of topically. The photodrug test is generally used for diagnosis of drug-induced hypersensitive diseases.

3. Allergy test

The tests for allergic reactions to a specific antigen are largely divided into those for type I allergy (immediate) and those for type IV allergy (delayed). A scratch test and an intracutaneous reactivity test are conducted for type I allergy; a patch test and an intracutaneous reactivity test are conducted for type IV allergy. ELISA and Western blot test are performed to detect the antibody in autoimmune blistering diseases.

1) Patch test

The patch test, for detection of the antigen of contact dermatitis, is conducted by applying the antigen to normal skin to observe the reaction. The antigen that is suspected of causing allergy is mixed in a vehicle of a topical agent such as white petrolatum and spread on an adhesive plaster or put in a Finnchamber (a plaster to which an aluminum plate is affixed). The plaster is adhered to a site of normal skin (usually the back or the upper inner arm). After 48 hours, the patch is removed, and the test result is determined in about 20 minutes when stimulation caused by the plaster has subsided. If reddening, edema, papule or erosion is produced, the test is considered to be positive for allergy (Fig. 5.6, Table 5.1). The site may be observed after 72 hours and 96 hours for more reliable results. A series of diluted test substances is used for the test. In cases in which the result is positive only when the test substance is diluted to a certain level...

Table 5.1 Readings and interpretation of patch test reactions.

<table>
<thead>
<tr>
<th>Japanese criterion</th>
<th>ICDRG criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Negative</td>
<td>— Negative</td>
</tr>
<tr>
<td>± Faint erythema</td>
<td>+ Doubtful reaction; faint erythema only</td>
</tr>
<tr>
<td>+ Erythema</td>
<td>+ Weak positive reaction; palpable erythema, infiltration, possibly papules</td>
</tr>
<tr>
<td>† Edematous erythema</td>
<td>† Strong positive reaction; erythema, infiltration, papules, vesicles</td>
</tr>
<tr>
<td>†† Infiltrative erythema, papules, vesicles</td>
<td>†† Extreme positive reaction; intense erythema and infiltration and coalescing vesicles</td>
</tr>
<tr>
<td>††† Coalescing vesicles</td>
<td>IR Irritant reaction of different types</td>
</tr>
<tr>
<td></td>
<td>NT Not tested</td>
</tr>
</tbody>
</table>

ICDRG: International Contact Dermatitis Research Group
or higher, it is considered the primary irritant (Chapter 7).

2) Scratch test

The scratch test is a simple test to detect an immediate allergen (type I allergy). The flexor surface of the forearm is scratched with a needle or a needle-like tool without drawing blood, and one drop of antigen solution is applied to the forearm (Fig. 5.7). If the patient is allergic to the allergen, reddening or swelling is produced on the spot. The diameter of the reddening or swelling along the minor axis is measured 15 to 20 minutes after application for identification of the allergy (Table 5.2).

A scratch test may cause shock in patients with a history of anaphylactic shock. Therefore, the antigen solution should be tested first on normal skin to see whether urticaria is produced in 30 minutes (open test). If the result of the open test is positive, it is unnecessary to perform a scratch test or an intracutaneous reactivity test.

3) Intracutaneous test
(type I allergy test, type IV allergy test)

Type I allergens can be detected by intracutaneous test 1. In this, 0.02 ml of a solution containing the suspected substance is injected intradermally, and if an urticarial lesion or pseudopodial-like projection occurs within 15 to 20 minutes, the test is determined to be positive (Table 5.3). Since there is a risk of causing anaphylactic shock in the intracutaneous reactivity test, it is desirable to perform a scratch test in advance to determine the severity of the reaction.

Intracutaneous test 2 is conducted to examine the strength of cellular immunity against an antigen. Forty-eight hours after intradermal injection of 0.1 ml of the solution containing the suspected substance, if the reddening or swelling along the minor axis averages 10 mm or more, the result is generally considered positive to allergy. Common intracutaneous tests are listed in Table 5.4.

4) Drug-induced lymphocyte stimulation test
(DLST)

The drug-induced lymphocyte stimulation test (DLST) is known to be useful in identifying drug-induced eruptions associated with T cells; however, the involvement of a drug cannot be ruled out even when the results are negative, because of the low sensitivity of the test. DNA synthesis accompanying a lymphocyte proliferative reaction can be determined by $^3$H-thymidine after peripheral blood lymphocytes are cultured with a drug.
5) Drug challenge test

The drug suspected of causing allergy is administered to the patient to determine whether the eruptions will recur. One one-hundredth to one tenth of the usual dosage is given orally. In serious drug eruptions, there is a high risk that a drug challenge test will cause anaphylactic shock. The drug challenge test is the most reliable allergy test.

4. Skin function test

Tests for measuring various skin function, such as temperature control, secretion, and vascular regulation, are as follows.

1) Measurement of skin temperature and thermography

Thermography, which uses an infrared-camera-equipped emission pyrometer to express the distribution of skin temperature two-dimensionally, has become widely used for diagnosing diseases of the blood vessels, and nervous system disorders, inflammations, tumors, and other disorders.

2) Transepidermal water loss (TEWL)

Transepidermal water loss (TEWL) from the skin surface is measured by an electric hygrometer (Fig. 5.8). This test is effective in determining the clinical condition of keratinization. The TEWL value usually is elevated in dyskeratoses, such as in ichthyosis.

3) Skin capillary resistance test

The fragility of skin capillaries can be determined by measuring ecchymosis produced in artificially pressured blood vessels. In the Rumpel-Leede test, the upper arm is pressed by a blood pressure manchette to congest the blood vessels. Two minutes after pressure between the systolic and diastolic pressures is applied to the patient’s upper arm for 5 minutes to constrict the blood vessels, hemorrhagic spots occur. When 10 hemorrhagic spots or more produced, the test is positive for dysfunction of vascular regulation. It may also be positive if there is abnormality in the capillaries or platelets, such as Henoch-Schönlein purpura or thrombocytic purpura.

5. Fungal examination

Potassium hydroxide (KOH) is used for observation and detection of fungi and mites. Scales or blister contents are swabbed (Fig. 5.9) and applied to a glass slide onto which 20% KOH solution is dripped, and a slide cover is placed on top. The slide is...