

Quantification of serum IgE in patients with burns

G. J. GLEICH, S. L. DUNNETTE, F. J. VOLENEC
and M. M. MANI

Department of Medicine, and Department of Immunology, Mayo Clinic and Mayo Foundation, Rochester, Minnesota, and the Gene and Barbara Burnett Burn Center, Department of Surgery, University of Kansas Medical Center, Kansas City, Kansas, U.S.A.

(Received 6 May 1978; accepted for publication 8 August 1978)

Summary

IgE levels in the serum of individuals with burns were sequentially measured and compared to IgE levels in normal control blood donors. Following a burn, the levels of IgE protein showed a significant, although modest, increase, usually evident between days 14 and 22. In an occasional patient, the IgE levels rose by as much as five times in value during this period. Because of the complexity of the clinical situation associated with the burn patients, we cannot ascribe these elevations of IgE to the burn *per se*, but must consider the possibility of other factors, especially those involved in the treatment of the burn as well as the infection. The magnitude of the elevation of IgE in the burn patients (geometric mean = 272 ng/ml) was considerably lower than the magnitude of the elevations seen in atopic dermatitis and generalized neurodermatitis (geometric means = 2265 and 2071 ng/ml, respectively). Thus simple trauma to the skin is not a sufficient explanation for the elevated serum IgE levels in atopic dermatitis and generalized neurodermatitis.

Introduction

Quantification of the serum immunoglobulin E (IgE) in disease has revealed that there are great increases in IgE in most patients with atopic dermatitis (Clendenning *et al.*, 1973; Graul *et al.*, 1973; Gurevitch, Heiner & Reisner, 1973; Juhlin *et al.*, 1969; Ogawa *et al.*, 1971; Stone, Muller & Gleich, 1973; Wüthrich, Kopper & Virchow, 1973), and recent reports have shown that IgE is increased in many other dermatological diseases (Krueger *et al.*, 1973; O'Loughlin *et al.*, 1977; Winkelmann & Gleich, 1973). These include neurodermatitis, contact dermatitis, various non-specific dermatitides and psoriasis (O'Loughlin *et al.*, 1977). The levels of IgE are greatly increased in patients with atopic dermatitis and neurodermatitis, whereas in the other cutaneous diseases the increases, though significant, are smaller (O'Loughlin *et al.*, 1977). In

Correspondence: Dr G. J. Gleich, Allergic Diseases Research Laboratory, Mayo Clinic, Rochester, Minnesota 55901, U.S.A.

prior studies a relationship had been found between the extent of the atopic dermatitis and the level of IgE (Ogawa *et al.*, 1971; Stone *et al.*, 1973). These results indicated that increases in IgE may be seen in a variety of clinical conditions in which inflammation of the skin is paramount and that any damage to the skin might increase the level of IgE. In this study we examined this hypothesis by investigation of the IgE levels in patients with burns.

Materials and methods

Patients

Individuals with burns were inpatients in the Burn Unit at the University of Kansas Medical Center, Kansas City, Kansas. The extent of the burns and the agents responsible for the burns are listed in Table 1. None of the patients gave a personal history of atopic diseases, including hay fever, urticaria or asthma.

Measurement of IgE

IgE levels in the sera of the burn patients were measured by a competitive binding radioimmunoassay (Gleich, Averbek & Swedlund, 1971). In our initial report of this assay we analysed sera from ninety-five individuals free from allergic disease and found an arithmetic mean of 179 ng/ml, a median of 80 ng/ml and a 94% confidence interval of 6–780 ng/ml (Gleich *et al.*, 1971). Recently we analysed the sera from thirty healthy blood donors and obtained an arithmetic mean of 114 ng/ml, a median of 58 ng/ml, and a 95% confidence interval of 1–699 ng/ml. The results from the thirty healthy blood donors were used for comparison with the patients in this study. The data from the literature indicate that the relationship between international units (iu) and ng is $1.0 \text{ iu} = 2.35 \text{ ng}$ (Bazara & Hamburger, 1972; Yunginger & Gleich, 1973).

Statistical analysis

t-Tests were performed using the logarithms of IgE levels to correct for the skewed distribution of these values.

Results

The results are shown in Table 1 and Figs 1 and 2. In initial experiments we analysed serial blood samples from several patients at approximately weekly intervals for their content of IgE after the burn. The results in the six patients (patients 1, 2, 4, 7, 9 and 20) from whom sera were available on the day after the burn indicate that there was a definite rise in the IgE level following the burn, peaking between about days 14 and 22 ($P < 0.01$). In some patients these rises were striking and the IgE level rose by as much as five times in value (patient 7). Comparison of the IgE levels in these six patients using serum samples obtained on the day after the burn revealed no difference from our normal control group of thirty healthy blood donors, whereas blood samples taken at the time of the maximum elevation of the IgE level revealed a significant difference from the control group ($P < 0.01$). In the remaining patients fewer samples of blood were obtained, so that the sequence of change of IgE levels could not be determined. It may be seen (Table 1) that in some patients the levels

Table 1. Serum IgE levels of twenty patients at post-burn intervals

Patient number	Age (years)	Sex	Incident	Degree	Burn		Serum IgE (ng/ml)
					Area of surface (%)	Day post-burn	
1	53	M	Flame	Second Third	10 60	1	<15
						4	18
						15	36
						29	56
2	73	M	Flame	Third	20	1	58
						4	78
						15	120
						29	106
3	55	M	Flame	Second Third	12 15	7	98
						11	106
						18	126
						21	134
4	74	F	Flame	Second Third	6 40	1	34
						8	58
						32	53
5	24	M	Flame	Second Third	4.5 5.5	7	80
						10	86
						17	86
						20	78
6	54	M	Gasoline explosion	Second	57	8	118
						15	115
						22	72
7	45	M	Grain explosion	Second	36	1	210
						4	279
						8	457
						15	1097
						26	775
8	26	M	Gasoline explosion	Second Third	46 30	47	135
						50	176
						54	157
						61	210
						68	237
						72	245
						96	695
9	39	M	Grain explosion	Second Third	13 47.5	1	190
						5	296
						15	223
						22	611
						26	290
						43	179
						50	216
10	23	M	Gasoline flame	Second	85	57	200
						26	2300
						30	2520
11	29	M	Hot liquid, flame (asphalt)	Second Third	30 40	37	2120
						6	237
						46	198
						53	144
						56	210

Table 1 (cont.)

Patient number	Age (years)	Sex	Burn			Day post-burn	Serum IgE (ng/ml)
			Incident	Degree	Area of surface (%)		
12	17	M	Gasoline explosion	Second	74	8	190
				Third	11.5	15	220
						18	290
						22	270
13	18	M	Gasoline flame	Second	21	7	1072
				Third	21	35	605
						61	259
14	50	F	Gasoline explosion, sepsis day 6	Second	40	8	180
						15	120
						22	160
15	35	M	Flame	Second	15	6	170
				Third	10		
16	17	M	Flame	Second	12.5	8	596
						11	540
						15	533
						22	376
17	63	F	Flame	Second	5	19	70
				Third	40	26	90
18	28	M	Flame	Second	35	32	132
				Third	10	35	119
						39	169
19	33	M	Gasoline explosion	Second	15	8	384
				Third	15	11	433
						15	550
						22	402
						29	256
20	37	M	Steam scald	Second Third	39 1	33	253
						1	64
						4	116
						8	206
						15	710
						22	210
						26	131

of IgE were quite high and remained high (patient 10), whereas in others the levels of IgE were normal and showed little change (patient 5). Comparison of the IgE levels (mean of all values in Table 1) in all twenty burn patients (geometric mean = 272 ng/ml) to the levels in healthy blood bank donors (geometric mean = 63 ng/ml) revealed a significant difference ($P < 0.001$). In several patients rather marked changes in the IgE level were seen in a comparatively short period of time, for example in patients 7, 9 and 20. These sera, and others showing such changes (patients 8 and 13), were analysed twice in separate radioimmunoassays, and comparable changes in the IgE level were found in both experiments.

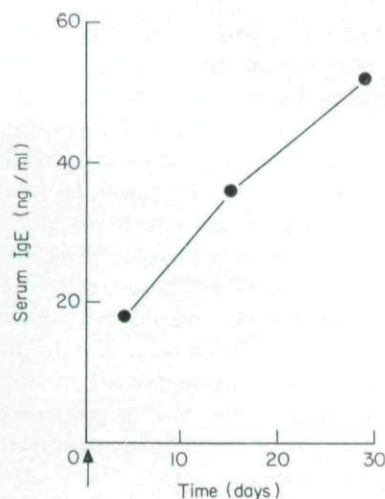


Fig. 1. Serum IgE at various times post-burn in patient 1 (male, age 53 years). On the first day post-burn, the serum IgE was <15 ng/ml. The burn (arrow) was due to flame, 10% body surface second degree, 60% third degree.

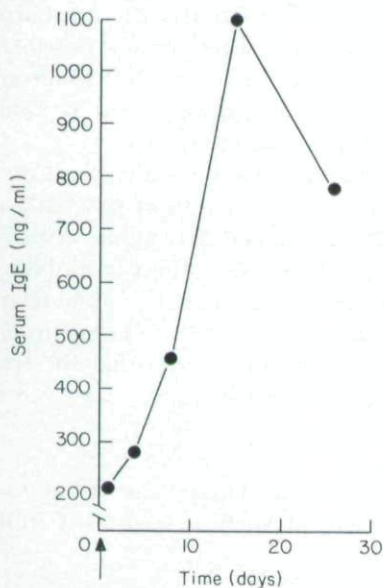


Fig. 2. Serum IgE at various times post-burn in patient 7 (male, age 45 years). The burn (arrow) was due to grain explosion, 36% body surface second degree.

Discussion

Our results indicate that following a burn there is a significant increase in the level of IgE in the serum. In these patients, it appears that the maximum IgE level is reached at approximately 14–22 days, after which the IgE concentration begins to drop. These results are in general agreement with those of Arturson *et al.* (1969), who measured

immunoglobulin levels, including IgE, in burn patients by radial immunodiffusion and by the radioimmunosorbent technique. They reported an initial decline in all immunoglobulin classes within the first 2 days and normal levels were reached by 30 days post-burn. In the case of IgE, the initial decrease during the first 2 days was relatively slight, about 10%, and the results in different patients showed great individual variation. In two of their eleven patients the serum IgE levels increased ten-fold to above-normal values during the first 2 weeks. The range of concentrations at 15 days they found was approximately the same as we found, namely 40 to 1000 ng/ml. The changes in IgE observed in the burn patients in this study are likely related to the burn and its consequences. Analyses of levels of IgE in normal individuals over a 7 month period showed an average maximal change of 46% (Yunginger & Gleich, 1973), whereas in six burn patients from whom blood was available on day 1 there was an average change of 350%.* These changes are most probably due to increased synthesis of IgE, because studies in patients with a variety of diseases have not shown differences in the half-life, which averages 2.7 days in normal subjects (Iio *et al.*, 1977).

In our experiments we compared the values obtained in the burn patients to values obtained in healthy blood bank donors, although we recognize that this control group is not adequate. The patients with burns were acutely ill and received a variety of treatments, including the application of topical antimicrobials to the injured surface as well as intensive therapy with fluids and blood products immediately after the burn incident. Moreover, all of these patients developed cutaneous infections as a function of the disruption of the normal protective layer of the skin. Therefore, the change in IgE levels which we have observed cannot be ascribed simply to the injury to the skin because it is likely that a variety of other factors influenced the IgE levels.

Nonetheless, these results indicate that even severe burns do not result in elevations of the IgE comparable to those seen in patients with atopic dermatitis or generalized neurodermatitis, where the geometric means are 2265 ng/ml and 2071 ng/ml, respectively (O'Loughlin *et al.*, 1977). Rather, the levels are comparable to those in psoriasis (geometric mean = 219 ng/ml) and non-specific dermatitides, including nummular dermatitis and eczematoid dermatitis (geometric mean = 317 ng/ml) (O'Loughlin *et al.*, 1977). Thus simple trauma to the skin is not a sufficient explanation for the elevated serum IgE levels in atopic dermatitis and neurodermatitis.

Acknowledgments

Supported in part by grants from the National Institute of Allergy and Infectious Diseases (AI 11483) and the National Institute of General Medical Sciences (I ROI GM23147-01).

References

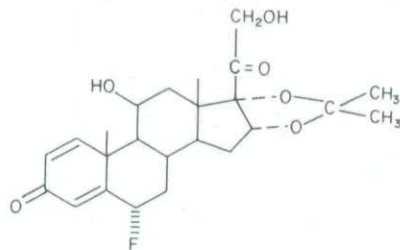
- ARTURSON, G., HÖGMAN, C.F., JOHANSSON, S.G.O. & KILLANDER, J. (1969) Changes in immunoglobulin levels in severely burned patients. *Lancet*, **i**, 546.
- BAZARAL, M. & HAMBURGER, R.N. (1972) Standardization and stability of immunoglobulin E (IgE). *Journal of Allergy and Clinical Immunology*, **49**, 189.
- CLENDENNING, W.E., CLACK, W.E., OGAWA, M. & ISHIZAKA, K. (1973) Serum IgE studies in atopic dermatitis. *Journal of Investigative Dermatology*, **61**, 233.

* These values were derived by computing the absolute maximal differences in IgE between the day 1 serum and subsequent samples and dividing this number by the IgE level in the day 1 serum. These quotients were converted to percentages and averaged.

- GLEICH, G.J., AVERBECK, A.K. & SWEDLUND, H.A. (1971) Measurement of IgE in normal and allergic serum by radioimmunoassay. *Journal of Laboratory and Clinical Medicine*, **77**, 690.
- GRAUL, E.H., BORELLI, S., MÜLLER, H. & GEHRKEN, H. (1973) Immunoglobulin E-Bestimmung bei Dermatosen. *Hautarzt*, **24**, 235.
- GUREVITCH, A.W., HEINER, D.C. & REISNER, R.M. (1973) IgE in atopic dermatitis and other common dermatoses. *Archives of Dermatology*, **107**, 712.
- IIO, A., STROBER, W., BRODER, S., POLMAR, S.H. & WALDMANN, T.A. (1977) The metabolism of IgE in patients with immunodeficiency states and neoplastic conditions. *Journal of Clinical Investigation*, **59**, 743.
- JUHLIN, L., JOHANSSON, S.G.O., BENNICHT, H., HÖGMAN, C. & THYRESSON, N. (1969) Immunoglobulin E in dermatoses: levels in atopic dermatitis and urticaria. *Archives of Dermatology*, **100**, 12.
- KRUEGER, G.G., KAHN, G., WESTON, W.L. & MANDEL, M.J. (1973) IgE levels in nummular eczema and ichthyosis. *Archives of Dermatology*, **107**, 56.
- OGAWA, M., BERGER, P.A., MCINTYRE, O.R., CLENDENNING, W.E. & ISHIZAKA, K. (1971) IgE in atopic dermatitis. *Archives of Dermatology*, **103**, 575.
- O'LOUGHLIN, S., DIAZ-PEREZ, J.L., GLEICH, G.J. & WINKELMANN, R.K. (1977) Serum immunoglobulin E in dermatitis and dermatosis: an analysis of 497 cases. *Archives of Dermatology*, **113**, 309.
- STONE, S.P., MULLER, S.A. & GLEICH, G.J. (1973) IgE levels in atopic dermatitis. *Archives of Dermatology*, **108**, 806.
- WINKELMANN, R.K. & GLEICH, G.J. (1973) Chronic acral dermatitis: association with extreme elevations of IgE. *Journal of the American Medical Association*, **225**, 378.
- WÜTHRICH, B., KOPPER, E. & VIRCHOW, C. (1973) IgE-Bestimmung bei Neurodermitis und anderen Dermatosen. *Hautarzt*, **24**, 381.
- YUNGINGER, J.W. & GLEICH, G.J. (1973) Seasonal changes in serum and nasal IgE concentrations. *Journal of Allergy and Clinical Immunology*, **51**, 174.

Erratum

In the paper 'Flunisolide—a new intranasal steroid for the treatment of allergic rhinitis' by J. N. Sahay, S. S. Chatterjee and C. Engler, which appeared in *Clinical Allergy*, **9**, No. 1, Fig. 1 was incorrectly reproduced. The correct formula appears below.



This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.