

PDF hosted at the Radboud Repository of the Radboud University Nijmegen

This full text is a publisher's version.

For additional information about this publication click this link.

<http://hdl.handle.net/2066/14732>

Please be advised that this information was generated on 2014-11-11 and may be subject to change.

J.K. is a Berry Trust scholar from the Postgraduate Institute of Medical Education and Research, Chandigarh, India.

Requests for reprints should be addressed to A.S.D.S., M.R.C. Leukæmia Unit, Royal Postgraduate Medical School, Du Cane Road, London W12 0HS.

REFERENCES

- Galton, D. A. G., Spiers, A. S. D. *Prog. Hemat.* 1971, 7, 343.
- Baikie, A. G. *Aust. Ann. Med.* 1968, 17, 175.
- Sokal, J. E., Aungst, C. W., Grace, J. T. *N.Y. St. J. Med.* 1973, 73, 1180.
- Dibromomannitol Cooperative Study Group. *Euro. J. Cancer*, 1973, 9, 583.
- Spiers, A. S. D., Galton, D. A. G., Kaur, J., Goldman, J. M. *Lancet*, 1975, i, 829.
- Spiers, A. S. D., Baikie, A. G., Galton, D. A. G., Richards, H. G. H., Wiltshaw, E., Catovsky, D., Spencer, J., Peto, R. *Br. med. J.* 1975, i, 175.
- Meeker, W. R., de Perio, J. M., Grace, J. T., Stutzman, L., Mittelman, A. *Surg. Clins. N. Am.* 1967, 47, 1163.
- Canellios, G. P., Nordland, J., Carbone, P. P. *Cancer*, 1972, 29, 660.
- Baikie, A. G. *Acta hæmat.* 1966, 36, 157.
- Spiers, A. S. D., Costello, C., Catovsky, D., Galton, D. A. G., Goldman, J. M. *Br. med. J.* 1974, iii, 77.
- Prosnitz, L. R., Nuland, S. B., Kligerman, M. M. *Cancer*, 1972, 29, 44.
- Mayo, W. J. *Am. J. med. Sci.* 1926, 171, 313.
- Mayo, W. J. *Am. J. Surg.* 1928, 88, 409.
- Mittelman, A., Stutzman, L., Grace, J. T. *Geriatrics*, 1968, 23, 142.
- Strumia, M. M., Strumia, P. V., Bassert, D. *Cancer Res.* 1966, 26, 519.
- Gomez, G., Hossfeld, D. K., Sokal, J. E. *Br. med. J.* 1975, ii, 421.
- Ogawa, M., Fried, J., Sakai, V., Strife, A., Clarkson, B. D. *Cancer*, 1970, 25, 1031.

NEW FAMILIAL DEFECT IN MICROBICIDAL FUNCTION OF POLYMORPHONUCLEAR LEUCOCYTES

JOS W. M. VAN DER MEER THEDA L. VAN ZWET
RALPH VAN FURTH

Laboratory for Cellular Immunology, Department of Infectious Diseases, University Hospital Leiden

CORRY M. R. WEEMAES

Department of Pædiatrics, University Hospital, Nijmegen, The Netherlands

Summary A family is described in which a defect in intracellular killing affected two, and probably three, siblings of both sexes. From an early age they have had recurrent severe infections. During these episodes their white-blood-cell count became very high. This familial disorder seems to differ from previously reported syndromes of abnormal leucocyte function.

Introduction

Phagocytosis and subsequent killing of ingested microorganisms by granulocytes and mononuclear phagocytes is one of the major mechanisms in host defence. Defects in phagocytic or microbicidal function predispose individuals to severe infections.^{1,2} We describe a familial disorder of intracellular killing in which one female and at least one (probably two) male siblings were affected.

Case-reports

Case 1 is a boy born in 1963 who first received medical attention because of recurrent otitis media. In 1967 and 1969 he was admitted to hospital because of stomatitis, gingivitis, and tonsillitis caused by *Staphylococcus aureus*, β -hæmolytic streptococci, and *Candida albicans*. In 1970 skin lesions developed for the first time. These were diagnosed as pyoderma gangrenosum. In 1971 he was admitted to the Nijmegen Univer-

sity Hospital with a suppurative pericarditis caused by *Staph. aureus* which required pericardiectomy as well as antibiotic treatment. In 1972 he had a subperiosteal abscess of the right tibia caused by *Staph. aureus* from which he recovered after drainage and antibiotic therapy. In 1974 he was admitted to the same hospital with severe pneumonia. Although no causative microorganisms were found, he recovered with antibiotic treatment. During all these episodes of infection his white-blood-cell count (w.b.c.) became very high (25 000-55 000/mm³), the vast majority of cells being neutrophil leucocytes, with only a slight shift to the left. In between the infections the w.b.c. was normal. When leucocyte function was studied (April, 1974) he had no infections, and, apart from scars from operations and from skin infections, no abnormalities were found on physical examination.

Case 2 is a female born in 1951, who has had severe recurrent pyoderma from her first year of life. These skin lesions were generally caused by *Staph. aureus*, but β -hæmolytic streptococci (group A) or *Proteus mirabilis* organisms were sometimes responsible. In 1958 she had severe laryngotracheobronchitis of unknown cause, for which a temporary tracheostomy was necessary. Since 1958 she has been on corticosteroid therapy, which severely retarded her growth. In 1971 she had an uncomplicated pregnancy. In 1974 she was admitted to hospital on several occasions with erosive gastritis and œsophageal candidiasis, which was treated with antimycotic agents. Several attempts were made to withdraw corticosteroid therapy, but she always managed to obtain supplies from elsewhere. There was pronounced leucocytosis during episodes of infection. The w.b.c. became normal once the infection had subsided. When leucocyte-function was studied (April, 1975) her growth was found to be retarded (height 150 cm) and her appearance was cushingoid. Apart from scars of healed skin lesions and of a tracheostomy there were no other abnormalities.

Case 3 was a male born in 1949, who had had pyoderma from his first year of life. From 1952 until 1954 he was in a sanatorium with tuberculosis. From 1958 until 1964 he was on corticosteroid therapy. In 1960, 1963, 1965, and 1966 he had repeated attacks of pneumonia. He also had recurrent episodes of gingivitis, otitis, and sinusitis. In 1968 he had an abscess in his jaw and severe pneumonia with hæmoptysis. A tracheostomy was performed, and despite all therapeutic measures (antibiotics, transfusions, and oxygen) he died in February, 1969. During this infection his leucocyte-count rose to 64 000/mm³. Leucocyte function was not tested. At necropsy, bronchiectasis and extensive pulmonary necrosis with abscesses were found.

The Pedigree

The family (fig. 1) belongs to a closed community living in caravans, leading a gipsy-like life. However, consanguinity is not likely because the mother married into this community, her family always having led a settled life.

The father has had perianal fistulas since 1959, but gave no history of pyoderma or of any serious infection, apart from a wound infection after cholecystectomy. Apart from obesity, no physical abnormalities were noted. The mother was a healthy

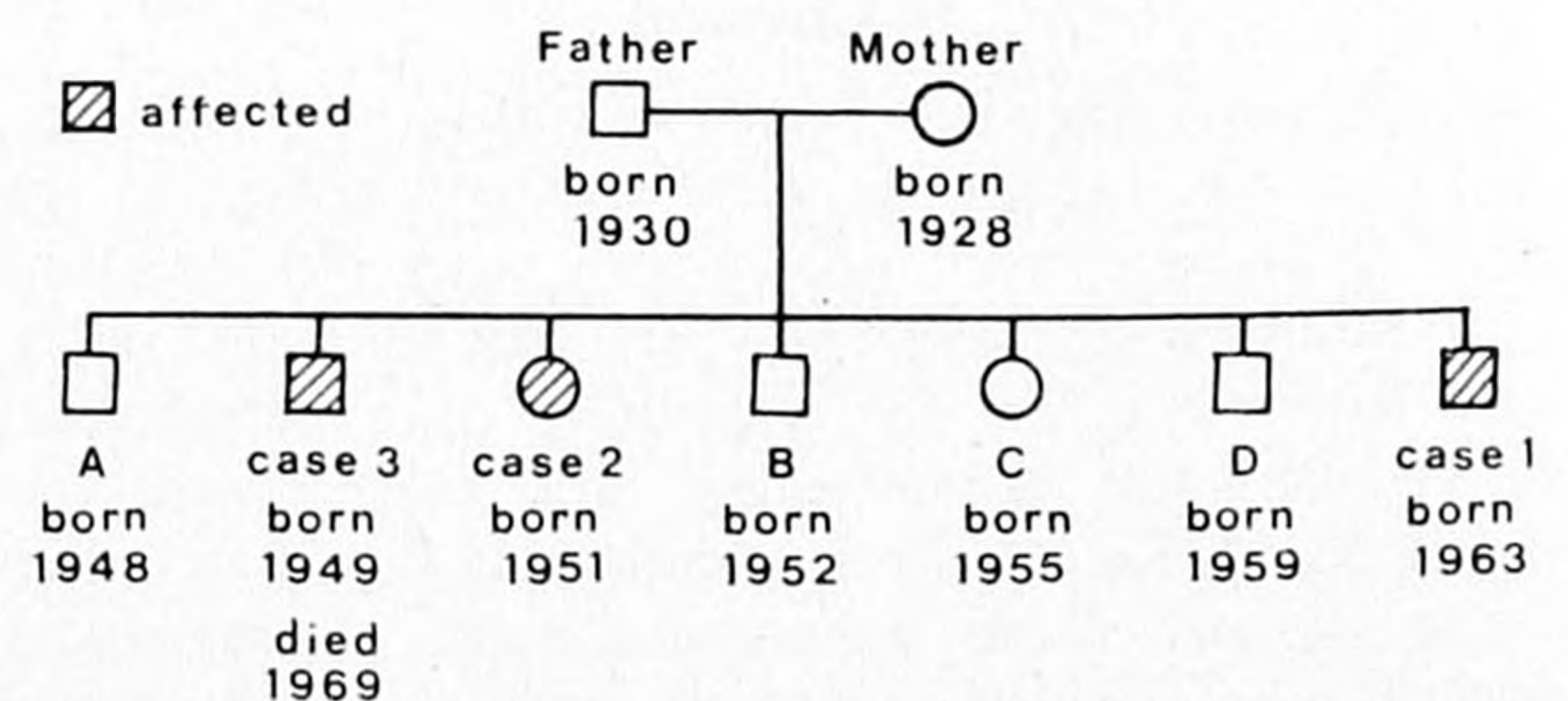


Fig. 1—Family pedigree.

TABLE I—LEUCOCYTE FUNCTION

Family members	Recurrent infections	Phagocytosis (%)		Intracellular killing (%)		Opsonic activity (%)	
		60 min	120 min	60 min	120 min	60 min	120 min
Father	+	98.1	99.0	84.5	92.3	98.9	99.9
Mother	-	99.5	99.8	82.3	89.5	..	..
Sibling A	-	98.5	98.8	91.5	94.6	..	..
Case 3	++
Case 2	++	97.4	99.9	72.5	79.2	98.1	99.8
Sibling B	-	99.9	99.9	91.5	96.8	..	..
Sibling C	-	96.7	99.3	87.4	91.1	..	..
Sibling D	-	98.4	99.7	84.0	90.0	..	..
Case 1	++	98.9	99.8	72.0	80.0	93.7	99.7
Normal subjects*	..	96.3 +2.8	99.0 +1.1	83.2 +9.1	90.4 +3.2	96.3 +3.2	99.0 +1.1

* Mean ± s.d.

middle-aged woman, without a history of infections. Siblings A, B, C, and D were all in good health. Only D had been admitted to hospital because of some unknown skin disease and tiny areas of depigmentation could still be seen on his abdomen. The child of case 2 has had neither pyoderma nor any serious systemic infection. One of the father's brothers has probably had recurrent infections, but no further details are available.

Materials and Methods

Phagocytosis and intracellular killing by leucocytes were studied with a modification of the method of Cohn and Morse,³ which allows both processes to be measured independently.⁴ The microorganism used was *Staph. aureus* type 421. The opsonic activity of the serum was investigated by the same method as for phagocytosis, but using patient's serum instead

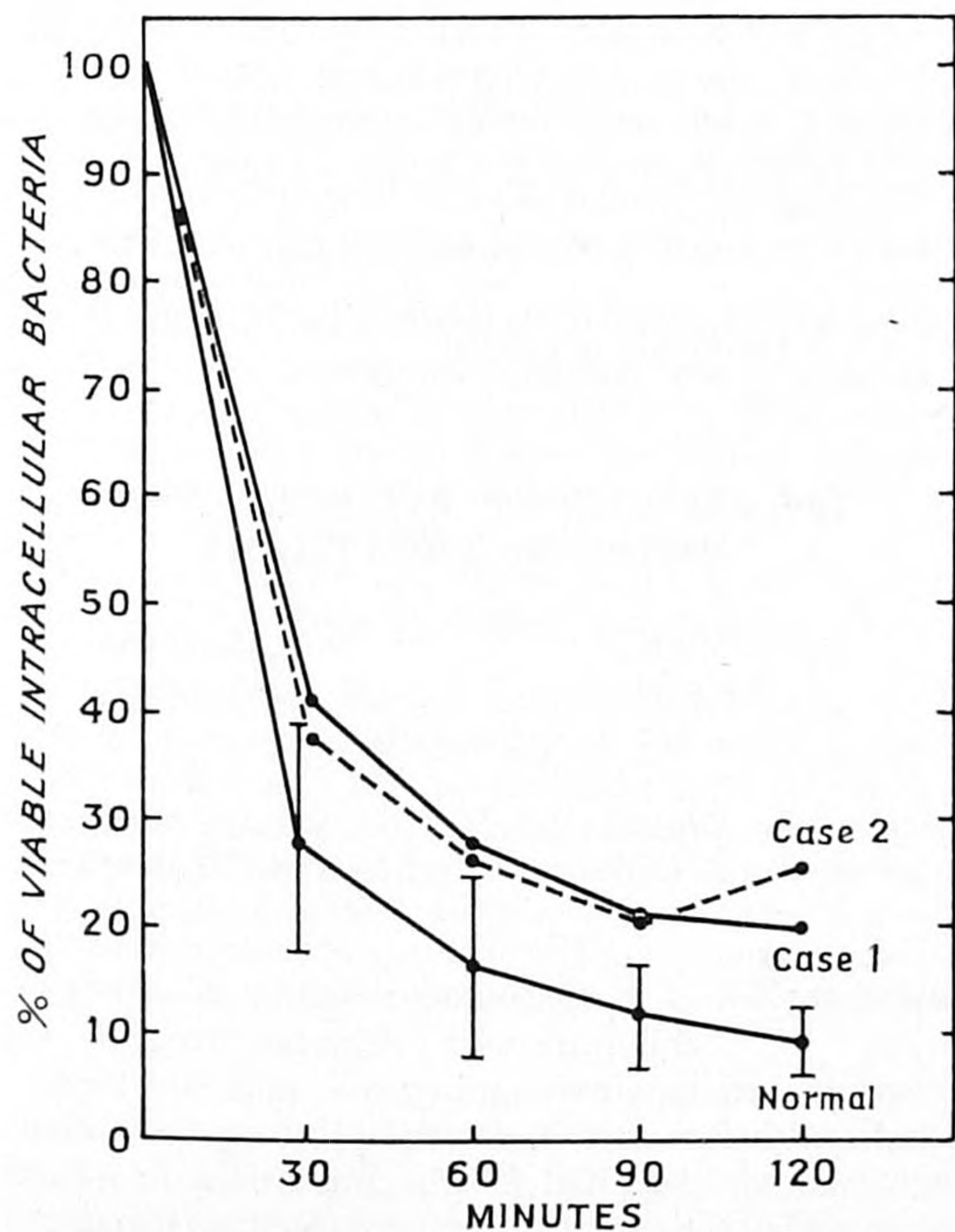


Fig. 2—Rate of intracellular killing of *Staph. aureus*. Number of viable intracellular bacteria is expressed as percentage of viable intracellular bacteria at time zero. Mean ± s.d. is given for 17 healthy individuals. Intracellular killing was significantly reduced at 90 and 120 minutes ($P \leq 0.01$) in cases 1 and 2.

of donor serum and normal leucocytes instead of those from the patient.

Peroxidase staining using Kaplow's method⁵ was performed on blood-smears. The glucose-6-phosphate-dehydrogenase (G.-6-P.D.) activity of the red blood-cells was assayed⁶ by Dr L. N. Went. Lymphocyte transformation was studied using phytohemagglutinin, pokeweed mitogen, and *C. albicans* extract as stimulants.

Immunoglobulins were measured in all family members by turbidimetric immunoassay (performed by Dr P. van Munster, Nijmegen). Total hemolytic complement was measured as the CH₅₀ value in a sheep-red-blood-cell/rabbit-antibody assay with fresh pooled human serum as a standard. C1q, C3 C4,

TABLE II—QUANTITATIVE SERUM-IMMUNOGLOBULIN STUDIES

Family members	IgG (mg/dl)	IgA (mg/dl)	IgM (mg/dl)	IgE (u/ml)
Father	967	15	86	..
Mother	977	284	133	..
Sibling A	899	152	101	..
Case 3	..	..	..	..
Case 2	495	168	62	150
Sibling B	1102	183	78	..
Sibling C	967	168	133	..
Sibling D	964	168	172	..
Case 1	1236	295	94	236
Normal subjects	800-1500	90-300	70-250	<300

TABLE III—HL-A AND BLOOD GROUPS

Family members	HL-A	ABO	Rhesus
Father	1, 8, W6/2, 7, W6	A	CcDee
Mother	1, 17, W4/2, W18, W6	A	ccdee
Sibling A	2, 7, W6/2, W18, W6	A	CcDee
Case 3	..	O	Positive
Case 2	1, 8, W6/1, 17, W4	O	ccDee
Sibling B	2, 7, W6/2, W18, W6	O	ccdee
Sibling C	2, 17, W6/2, W18, W6	O	CcDee
Sibling D	2, 7, W6/1, 17, W4	A	CcDee
Case 1	1, 8, W6/2, W18, W6	O	ccdee

and C5 were assayed by immunodiffusion using specific antisera (assayed by Dr K. Pondman, Amsterdam) HL-A and blood-groups were determined by Prof. J. J. van Rood.

Results

Studies on Leucocytes

In all family members the morphology of granulocytes, monocytes, and lymphocytes was normal by light microscopy. Peroxidase staining was positive in granulocytes and monocytes from cases 1 and 2. The total and differential w.b.c. of all family members were normal when the leucocyte functions were studied. The results of the studies on phagocytosis, intracellular killing, and opsonic activity (table 1) show that the granulocytes of all members of the family phagocytose normally. Intracellular killing of bacteria was defective in at 90 and 120 minutes ($P \leq 0.01$) (fig. 2). The opsonic activity of the serum of cases 1 and 2 and their father was normal (table 1), despite the low immunoglobulin levels in case 2 and the father (see below). The G.-6-P.D. activity of the red blood-cells was normal in cases 1 and 2. The in-vitro response of lymphocytes from case 1 to phytohemagglutinin, pokeweed mitogen, and *C. albicans* was normal.

Humoral Immunity

The results of quantitative serum-immunoglobulin studies (table II) were normal in most members of the

family, but in the father the IgA concentration was low and case 2 had low IgG and IgM concentrations (which she had had from an early age). All family members had normal total haemolytic complement levels. Cases 1 and 2 had normal levels of C1q, C3, C4, C5. After an attack of influenza in 1971, case 1 demonstrated a significant rise in influenza-B-antibody titre. Tests for rheumatoid factor (Rose test and latex fixation) and antinuclear factor were negative in all family members.

HL-A and Blood-group Typing

The HL-A haplotypes and blood-groups are given in table III. Cases 1 and 2 have HL-A 1 and HL-A 8 in common. Their father also has these antigens. All three affected siblings are blood-group O.

Discussion

This report describes a bactericidal defect of leucocytes in male and female siblings. A brother who died before this study was done, probably had the same defect of leucocyte function. The affected individuals have recurrent hypergranulocytosis. In both patients the defect of intracellular killing was detected when no infection was present and the leucocyte-count was normal. This is important, since it is known that that intracellular killing may be depressed in acute infection^{7,8} and extreme leucocytosis.⁹

How are our cases related to previously reported syndromes? The most extensively investigated microbicidal defect is chronic granulomatous disease (C.G.D.) which only affects boys and is usually carried by their mothers and sisters.¹⁰⁻¹² A variant of this syndrome has been described in females¹²⁻¹⁵ for which an autosomal mode of inheritance has been suggested. To our knowledge there is no report of a family with C.G.D. in which both male and female siblings are affected. The clinical pattern of C.G.D. is different from the patients we studied. Our patients had no recurrent lymphadenitis, no typical granulomas, and no liver and spleen enlargement. In addition biochemical studies of the leucocytes of our patients by Weening et al.¹⁶ demonstrated no stimulation of oxygen consumption, superoxide production, and hexose-monophosphate-shunt activity during phagocytosis of latex particles without opsonins, whereas, in contrast with the findings in C.G.D., stimulation of cell metabolism was normal after ingestion of IgG-coated latex particles. They also found that zymosan was not iodinated. In familial lipochrome histiocytosis the clinical signs are also different (e.g., arthritis, splenomegaly) and this disease has only been described in females.^{20,21}

It is unlikely that the defect reported here is due to G-6-P.D. deficiency, since in all reported cases of G-6-P.D. both leucocytes and red blood-cells showed G-6-P.D. deficiency.²²⁻²⁴ Myeloperoxidase deficiency,^{25,26} which is not a sex-linked defect, was excluded in our patients by a positive peroxidase stain. Unlike the patient with a bactericidal defect reported by Strauss et al.²⁷ the morphology of the leucocytes in our patients is normal. Comparison of our findings with other reports of sporadic cases of microbicidal defects is difficult because it is not known whether these conditions are inherited or acquired.²⁸⁻³⁰

The defect of intracellular killing in the family described here probably has a genetic basis. A relation between this disorder and HL-A antigens could not be

established since the antigens which were common to the affected individuals (HL-A 1,8) are very widespread in the general population.

We thank Ir Peter C. J. Leijh for statistical analysis; and Dr Richard W. Crofton, Dr L. N. Went, and Dr J. W. Bruning for their helpful comments.

Requests for reprints should be addressed to R.F.

REFERENCES

1. *Lancet*, 1974, i, 438
2. Stossel, T. P. *New Engl. J. Med.* 1974, **290**, 717, 774, 833.
3. Cohn, Z.A., Morse, S. I. *J. exp. Med.* 1959, **110**, 419.
4. Van Furth, R., van Zwet, T. L. in *Handbook of Experimental Immunology* (edited by D. M. Weir); p. 361. Oxford, 1973.
5. Kaplow, L. S. *Blood*, 1965, **26**, 215.
6. Motulsky, A. G., Yoshida, A. in *Biochemical Methods in Red Cell Genetics* (edited by J. J. Yunis); p. 51. New York, 1969.
7. McCall, C. E., Caves, J., Cooper, R., Dechatelet, L. R., *J. infect. Dis.* 1971, **124**, 68.
8. Solberg, C. O., Hellum, K. B. *Lancet*, 1972, ii, 727.
9. Messner, R. P., Reed, W. P., Palmer, D. L., Bolin, R. B., Davis, A. T., Quie, P. G. *Clin. Immun. Immunopath.* 1973, **1**, 523.
10. Holmes, B., Quie, P. G., Windhorst, D. B., Good, R. A. *Lancet*, 1966, i, 1225.
11. Windhorst, D. B., Holmes, B., Good, R. A. *ibid.* 1967, i, 737.
12. Baehner, R. L., Nathan, D. G. *New Engl. J. Med.* 1969, **278**, 971.
13. Quie, P. G., Kaplan, E. L., Page, A. R., Gruskay, F. L., Malawista, S. E. *ibid.* p. 976.
14. Azimi, P. H., Bodenbender, J. G., Hintz, R. L., Kontras, S. B. *J. Am. med. Ass.* 1968, **206**, 2865.
15. Douglas, S. D., Davis, W. C., Fudenberg, H. H. *Am. J. Med.* 1969, **46**, 901.
16. Weening, R. S., Roos, D., Homan-Müller, J., van Schayk, M. in *Future Trends in Inflammation II* (edited by C. P. Velo, D. A. Willoughby, and J. P. Giroud) Basle (in the press).
17. Ford, D. K., Price, G. E., Culling, C. F. A., Vassar, P. S. *Am. J. Med.* 1962, **33**, 478.
18. Bannatyne, R. M., Skowron, P. N., Weber, J. L. *J. Pediat.* 1969, **75**, 236.
19. White, L. R., Iannetta, A., Kaplan, E. L., Davis, S. D., Wedgwood, R. J. *Lancet*, 1969, i, 630.
20. Davis, S. D., Schaller, J., Wedgwood, R. J. *ibid.* 1966, i, 1013.
21. Hill, H. R., Ochs, H. D., Quie, P. G., Clark, R. A., Pabst, H. F., Klebanoff, S. J., Wedgwood, R. J. *ibid.* 1974, ii, 617.
22. Cooper, M. R., Dechatelet, L. R., Lavia, M. F., McCall, C. E., Spurr, C. L., Baehner, R. L. *J. clin. Invest.* 1970, **49**, 21a.
23. Baehner, R. L., Johnston, R. B., Nathan, D. G. *J. reticuloendoth. Soc.* 1972, **12**, 150.
24. Gray, G. R., Klebanoff, S. J., Stamatoyannopoulos, G., Austin, T., Naiman, S. C., Yoshida, A., Kliman, M. R., Robinson, G. C. F. *Lancet*, 1973, ii, 530.
25. Lehrer, R. I., Cline, M. J. *J. clin. Invest.* 1969, **48**, 1478.
26. Salmon, S. E., Cline, M. J., Schultz, J., Lehrer, R. I. *New Engl. J. Med.* 1970, **282**, 250.
27. Strauss, R. G., Bove, K. E., Jones, J. F., Mauer, A. M., Fulginiti, V. A. *ibid.* 1974, **290**, 478.
28. Davis, W. C., Douglas, S. D., Fudenberg, H. H. *Ann. intern. Med.* 1968, **69**, 1237.
29. Spitznagel, J. K., Cooper, M. R., McCall, A. E., Dechatelet, L. R., Welsh, I. R. H. *J. clin. Invest.* 1972, **51**, 93a.
30. Mandell, G. L. *Archs. intern. Med.* 1972, **130**, 754.

IgA DEFICIENCY, EPILEPSY, AND PHENYTOIN TREATMENT

J. SEAGER

J. WILSON

D. L. JAMISON

A. R. HAYWARD

J. F. SOOTHILL

Department of Immunology, Institute of Child Health, and Department of Neurology, Hospital for Sick Children, London WC1

Summary In a prospective study of thirty-two children with seizures treated with phenytoin (diphenylhydantoin), five had low levels of serum-IgA before treatment. All of these were among the fifteen who had had febrile convulsions in infancy. IgA levels fell significantly during 6 months treatment in the fourteen patients studied sequentially. Treated children with low serum-IgA had normal numbers of lymphocytes with surface IgA. This suggests that phenytoin causes failure of terminal differentiation of B lymphocytes.