carry out serial estimations in sera and possibly in CSF from patients with ON and with other initial symptoms suggestive of MS to elucidate the relationship of changes in antibody titres to the clinical progression of the disease.

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References

- Leibowitz, U, Alter, M, and Halpern, L, *Archives of Neurology*, 1966, 14, 459.
- McAlpine, D, in *Multiple Sclerosis: A Reappraisal*, ed D McAlpine, C E Lumsden, and E D Acheson, p 148. Edinburgh and London, Churchill Livingstone.
- Hutchinson, W M, submitted for publication.
- Adams, J M, and Imagawa, D T, *Proceedings of the Society for Experimental Biology and Medicine*, 1962, 111, 562.
- Brody, J A, et al, *Neurology*, 1972, 22, 492.
- Brown, P, et al, *Proceedings of the Society for Experimental Biology and Medicine*, 1971, 137, 956.
- Salmi, A A, Norrby, E, and Panelius, M, *Infection and Immunity*, 1972, 6, 248.
- Nikoskelainen, E, et al, *Acta Neurologica Scandinavica*, 1975, 51, 333.
- Link, H, Norrby, E, and Olsson, J-E, *New England Journal of Medicine*, 1973, 289, 1103.
- Link, H, and Müller, R, *Archives of Neurology*, 1971, 25, 326.
- Nikoskelainen, E, et al, *Acta Neurologica Scandinavica*, 1975, 51, 347.
- Haire, M, Fraser, K B, and Millar, J H D, *British Medical Journal*, 1973, 3, 612.
- Haire, M, Fraser, K B, and Millar, J H D, *Clinical and Experimental Immunology*, 1973, 14, 409.
- Haire, M, Millar, J H D, and Merrett, J D, *British Medical Journal*, 1974, 4, 192.
- Millar, J H D, *Multiple Sclerosis: A Disease Acquired in Childhood*. Springfield, Illinois, Thomas, 1971.
- Haire, M, Adair, B McC, and Fraser, K B, *Clinical and Experimental Immunology*, 1973, 14, 409.
- Arnason, B G W, et al, *Journal of the Neurological Sciences*, 1974, 22, 419.

Climate and painful crisis of sickle-cell disease in Jamaica

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Summary

In a 10-year retrospective study a close correlation was found between low temperatures and hospital admissions for severe painful crises of sickle-cell disease.

Introduction

The pathogenesis of the painful crisis of sickle-cell disease is often obscure, though it may be precipitated by infection, especially malaria, in the last trimester of pregnancy and the immediate post-partum period, and by acidosis after ammonium chloride ingestion. Climate may also be important, and there is a widely held impression that painful crises are more frequent in cold, damp periods of the year.¹⁻⁴ Diggs¹ noted this in Memphis, yet prospective studies over 14 years in one case and two years in 37 cases failed to show a seasonal relationship in respect of bone pain.⁵ No seasonal pattern was apparent in hospital admissions of children with sickle-cell crises in Chicago,⁶ yet a five-year retrospective study in Buffalo⁷ showed that admissions were more frequent in winter. The evidence is therefore conflicting, and we present here the results of a retrospective study of the seasonal incidence of painful crises in Jamaica.

Patients and methods

The patients attended the adult and paediatric sickle-cell clinics of the University Hospital of the West Indies, and all fulfilled the diagnostic criteria for sickle-cell (SS) disease.⁸ A painful crisis was defined as pain in the abdomen, chest, or limbs unexplained on any basis other than SS disease. Juxta-articular areas of limb bones were most commonly affected, and pyrexia and red urine were frequent. Pains associated with pregnancy or secondary to an obvious disease such as pneumonia were excluded since such episodes might confuse an assessment of the aetiological role of climate.

Records of painful crises were collected from three sources. Details of hospital admissions for painful crises in the 10-year period 1964-73 were obtained from the hospital notes of all patients registered at the sickle-cell clinic. Details of attendances in the casualty department during the five years 1969-73 were obtained from the casualty notes, patients subsequently admitted for severe pain being excluded. Review of the sickle-cell clinic notes for the same five-year period yielded episodes of mild pain treated at home.

"Maximum" temperature (1 pm), "minimum" temperature (7 am), and rainfall, recorded at a meteorological unit in central Kingston, were expressed as mean monthly values for the years 1964-73.

Results

Mean monthly minimum temperatures, rainfall, and number of painful crises are given in the table. Maximum temperatures were some 8-9°C higher than minimum temperatures, and a steady rise in minimum temperature occurred from 21°C in January to about 24°C in July. Rainfall varied, but December to April was generally dry, rain increased during May to September, and the rainy season occurred during October and November.

Yearly hospital admissions for severe painful crises increased over the 10-year period, from 4 in 1964 to 28 in 1973, reflecting at least in part an increase in overall hospital admissions. Admissions for crisis in any single month varied from 0 to 6. Painful crises as documented in all three sources followed similar seasonal patterns, with a higher incidence in the winter than in the summer. Since painful crises necessitating hospital admission were of a more uniform severity and also allowed exclusion of other precipitating factors, these crises were used in examining the relationship between crises and climatic

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Mean minimum temperature, rainfall, and number of painful crisis per month

Month	Minimum temperature (°C) 1964-73	Rainfall (mm) 1964-73	Painful crises			Total
			Pains at home 1969-73 (n = 153)	Casualty attendances 1969-73 (n = 66)	Hospital admissions 1964-73 (n = 161)	
January	21.1	20	3.0	2.4	2.0	7.4
February	21.23	15	3.8	2.6	1.4	7.8
March	21.7	23	3.4	1.0	1.9	6.3
April	22.4	23	2.6	1.6	1.6	5.8
May	23.67	89	2.0	1.2	0.8	4.0
June	24.23	66	2.0	0.6	0.6	3.2
July	24.3	33	2.2	0.2	0.9	3.3
August	24.2	104	1.4	0.6	1.4	3.4
September	23.9	84	1.2	0.8	1.4	3.4
October	23.4	155	2.2	1.8	0.8	4.8
November	22.78	89	4.2	0.2	1.7	6.1
December	21.8	35	2.6	0.2	1.6	4.4

features. Minimum temperatures were used in the analysis since the effect of cold was being investigated.

The relationship between temperature, rainfall, and severe painful crises is shown in fig 1. Rainfall and severe painful crises are expressed as three-month moving averages, in which the monthly average is calculated from the mean of the month and that of the preceding and succeeding months. This procedure smooths out pronounced variations between months. A close relationship between temperature and severe crises is apparent and is further supported by the negative linear correlation ($r = -0.78$; $P < 0.01$) shown in fig 2. There was a non-linear relationship between crises and rain, which may have been due to the relationship between rain and temperature. A multiple correlation coefficient negligibly higher than the correlation with temperature alone confirmed the major association with temperature. Further tests of statistical significance were not appropriate owing to the averaging procedures used.

FIG 1—Seasonal changes in temperature, rainfall, and admissions to hospital for painful crisis during 1964-73. Temperature is mean monthly "minimum" depicted on inverted scale. Rainfall is expressed as three-month moving average. Painful crises are based on three-month moving average ($n = 161$). Yearly cycle is plotted twice.

Discussion

The present study shows a seasonal variation in the occurrence of painful crisis in Jamaica, which may be related primarily to temperature change or may be secondary to other factors. A spurious relationship might occur if patients with painful crises were more readily admitted to hospital in winter, although the fact that the seasonal pattern applied also to crises not requiring hospital admission is against this. The seasonal pattern may reflect a viral or other infective agent responsible for the precipitation of painful crises. Seasonal variation in certain infective agents is well documented, and this hypothesis cannot be excluded.

On the other hand, evidence suggests the primary importance

FIG 2—Relationship between monthly "minimum" temperatures and monthly hospital admissions for painful crisis.

of environmental temperature. Lowering of the temperature leads to an increased viscosity of sickle-cell blood in vitro,⁹ which could contribute to stasis of the circulation in peripheral capillary beds. Immersion of the hand of an infant with SS disease in ice-cold water produced local swelling and oedema that simulated the hand-foot syndrome.¹⁰ Some adults with SS disease, when exposed to a low temperature in a tropical environment (20°C), develop symptoms simulating the painful crisis.³ Many Jamaican patients are convinced of the relevance of environmental temperature, noting transient pains especially at the coldest time in the early mornings and when swimming in the sea, particularly on hot days, when bathing may precipitate severe painful crises. The role of cold agglutinins and cryoglobulins in temperature-related painful crises is the subject of controversy and impossible to assess from the currently available evidence.¹¹⁻¹⁴

The pathological processes underlying the painful crisis are not clear, although recent evidence implicates the small-vessel obstruction common to many other complications of sickle-cell disease. Radioisotope scanning may show impaired bloodflow in the bone marrow during a painful crisis,^{15 16} and biopsies of sites of maximal tenderness have yielded necrotic marrow.¹⁵⁻¹⁷ These observations suggest that the painful crisis results from focal areas of marrow necrosis similar in origin to the dactylitis that occurs in young children.

The mechanism whereby a fall in environmental temperature may precipitate these avascular episodes is unknown. In normal persons, skin cooling leads to vasoconstriction with shunting of blood away from the superficial vascular bed. In steady-state SS disease this reflex appears to be lost, since skin cooling produces only a negligible fall in skin blood flow compared with controls.¹⁸ During the painful crisis "arterialisation" of the superficial venous blood of the forearm has been shown to occur.¹⁹ Since the oxygen saturation in the deep venous system of the arm was normal, it was postulated that arteriovenous shunting to the superficial veins occurred in the painful crisis. Both this shunting and the loss of reflex vasoconstriction may accentuate temperature loss. Clearly more knowledge is required on the patterns of peripheral blood flow both in the steady state and during the painful crisis of SS disease. Until this is available one must assume that there is some vascular mechanism operating in the painful crisis that disturbs the balance of marrow blood flow, compromising the perfusion in critical areas. A drop in environmental temperature may stimulate this vascular mechanism.

Requests for reprints should be sent to Dr G R Serjeant.

References

- Diggs, L W, *American Journal of Clinical Pathology*, 1965, **44**, 1.

- ² Konotey-Ahulu, F I D, *Lancet*, 1965, 1, 1003.
³ Addae, S, *Lancet*, 1971, 2, 1256.
⁴ Isaacs-Sodeye, W A, personal communication, 1974.
⁵ Diggs, L W, and Flowers, E, *Clinical Paediatrics*, 1971, 10, 697.
⁶ Seeler, R A, *Lancet*, 1973, 2, 743.
⁷ Amjad, H, Bannerman, R M, and Judisch, J M, *British Medical Journal*, 1974, 2, 54.
⁸ Serjeant, G R, *The Clinical Features of Sickle Cell Disease*. Amsterdam, Elsevier, 1974.
⁹ Rubinstein, E, *American Journal of Medicine*, 1961, 30, 95.
¹⁰ Marsden, P D, and Shah, K K, *Journal of Tropical Medicine and Hygiene*, 1964, 67, 31.
¹¹ McSweeney, J E, Mermann, A C, and Wagley, P F, *American Journal of Medical Science*, 1947, 214, 542.
¹² Burchmore, J W, et al, *Lancet*, 1962, 2, 1008.
¹³ Charmot, G, Reynaud, R, and Bergot, J, *Lancet*, 1963, 2, 540.
¹⁴ Robinson, M G, and Sathiapalan, R, *Lancet*, 1965, 2, 957.
¹⁵ Hammel, C F, et al, *British Journal of Haematology*, 1973, 25, 593.
¹⁶ Alavi, A, et al, *Journal of Nuclear Medicine*, 1974, 15, 1003.
¹⁷ Charache, S, and Page, D L, *Annals of Internal Medicine*, 1967, 67, 1195.
¹⁸ Ward, E E, in *Proceedings of 20th Scientific Meeting of Commonwealth Caribbean Medical Research Council*, St Lucia, April 23, 1975, p 15.
¹⁹ Manfredi, F, et al, *Circulation*, 1960, 22, 602.

Cervical diameter after suction termination of pregnancy

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Summary

The diameter of the internal cervical os was measured in several groups of patients in an attempt to assess any damage caused by suction termination of pregnancy. Pregnant women who had had a previous abortion by vacuum aspiration had significantly greater cervical diameters than those who had not, and there was a statistically significant correlation between dilatation of the cervix at operation and cervical diameter at six weeks' follow-up. Cervical dilatation to 10 mm or less was subsequently associated with a normal cervical diameter, but the diameter was often large when the extent of dilatation was greater than 12 mm or not known. Cervical dilatation at termination of pregnancy should, if possible, not exceed 10 mm.

Introduction

Cervical damage has long been recognised as a hazard of dilatation of the cervix for induced abortion. Reports from several countries have suggested an association between induced abortion and subsequent second trimester abortion or premature delivery. In none of these studies, however, was there a carefully matched control group. Furthermore, techniques of first trimester abortion have changed, and these figures do not necessarily apply to current methods.

Patients with cervical incompetence may be identified by an abnormally wide internal os diameter. The introduction of a simple method of measuring this diameter led to an attempt to assess this after abortion.

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Patients and methods

There were four groups of patients. Group 1 consisted of eight non-pregnant women with a history of at least two spontaneous mid-trimester abortions and a presumptive diagnosis of cervical incompetence. Group 2 consisted of 16 pregnant women whose cervix was measured at repeat suction termination of pregnancy. Group 3 consisted of 51 women who had their cervix measured six weeks after their only suction termination of pregnancy. Group 4 consisted of 17 non-pregnant women who had had a previous suction termination of pregnancy but who had not been pregnant in the past year.

The measurements were carried out as described.¹ The French catheter gauge system was used (1 gauge French = 0.33 mm). The results were compared with published normal values obtained from 99 pregnant and 41 non-pregnant women.¹ This study gave the following standard (mean $\pm$ SD) values: (a) a non-pregnant mean cervical diameter of 24.3 ± 3.1 French, (b) a nulliparous pregnant mean cervical diameter of 25.8 ± 3.1 French, and (c) a parous pregnant mean cervical diameter of 27.3 ± 3.3 French.

TABLE 1—Cervical measurements in patients who had had previous mid-trimester abortions (group 1)

Case No	Gravidity	Parity	History	Day of cycle	Cervical diameter (French gauge)
1	3	0	D and C for dysmenorrhoea (twice), 3 painless second trimester abortions	6	37
2	5	0	Suction termination of pregnancy (twice), 3 painless second trimester abortions (16, 19, and 22 weeks), cervical incompetence diagnosed on hystero-gram	26	40
3	4	0	Suction termination of pregnancy, 1 1st trimester abortion, 2 2nd trimester abortions, no details	9	30
4	3	0	16 Weeks abortion (pain and bleeding), 16 weeks abortion (spontaneous rupture of membranes, fairly painless labour), 13 weeks abortion	12	31
5	8	0	4 1st trimester, 4 2nd trimester miscarriages, several Shirodker sutures		24
6	5	3	D and C for dysmenorrhoea, 3 full-term pregnancies uneventfully, 16 weeks painless abortion, 20 weeks painless abortion	Not stated	32
7	4	2	2 Full-term uneventful pregnancies, 18 weeks abortion, 22 weeks abortion	Not stated	34
8	11	9	Suction termination of pregnancy, 28 weeks delivery, 36 weeks delivery, 8 miscarriages, the last at 22 weeks, several Shirodker sutures	Not stated	29

D and C = Dilatation and curettage.