IRON-CONTAINING CORNEAL RUST RINGS*† TREATED WITH DESFERRIOXAMINE

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INJURY to the cornea with an iron-containing foreign body usually leaves a rust ring. Most surgeons advise complete removal of any rust, but this often causes considerable trauma to the already injured cornea.

Desferrioxamine ("Desferal", Ciba Laboratories) is an iron-free compound isolated from a strain of *Streptomyces pilosus*, which binds ferric ions to form an octahedral complex ferrioxamine. Theoretically 100 parts by weight of desferrioxamine can bind 8.5 parts of ferric ion. It has been used with some success in the removal of experimental corneal rust rings in animals by Galin, Harris, and Papariello (1965) and in man by Valvo (1967). Wise (1966) found that desferrioxamine was not successful in the treatment of experimental siderosis bulbi, vitreous haemorrhage, and corneal blood-staining. The present study was designed to assess the value of topical desferrioxamine in the treatment of iron-containing corneal rust rings as compared with either surgical removal of the rust or expectant treatment.

Methods

Subjects were chosen from patients attending the Casualty Department of Moorfields Eye Hospital with an iron-containing corneal foreign body or rust ring. A history of the injury was taken including data concerning any previous attempted removal. The subjects' visual acuity was assessed, slit-lamp microscopy was performed, and the size of the corneal rust ring measured with calipers. Ophthalmoscopy was also carried out. If the causative foreign body was still present, it was surgically removed under slit-lamp microscopy using a Bowman's needle after local anaesthesia with gutt. amethocaine 1 per cent. The size of the rust ring was then assessed.

The surgeons of Moorfields Eye Hospital fell into three groups as far as their preference in the management of these cases was concerned:

TABLE I

Method of Treatment	No. of Patients
Surgical Removal	59
Desferrioxamine Ointment	48
Expectant	25
Total	132

- (1) Complete surgical removal of the rust ring;
- (2) 5 per cent. desferrioxamine ointment four times daily;
- (3) Expectant treatment.

Each patient was randomly assigned to one or other surgeon, thereby determining the management of the case (Table I).

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All patients were given gutt. hyoscine 0.25 per cent. statim and gutt. neomycin four times daily. The eye was dressed with a pad and knitted shield. Each patient was observed daily by the same observer and examined with the slit-lamp microscope, special note being taken of any lens opacities (see Conclusions). These examinations continued until there was no corneal reaction or staining with fluorescein solution. If the rust had not resolved after 10 days in Groups 2 and 3 it was then surgically removed. Of the desferrioxamine-treated group, nine failed to complete the follow-up examination.

Results

Resolution of the rust ring was considered to have occurred when the patient had a quiet eye with no rust remaining, a small corneal infiltrate, and no inflammatory reaction in the anterior chamber. The percentage of patients in each group showing resolution of the rust ring after 10 days' treatment is shown in Table II.

TABLE II
PERCENTAGE OF RUST RINGS RESOLVED AFTER 10 DAYS' TREATMENT

Treatment	Size of Rust Ring (mm.)				
	Total	0.2 and Under	0.3 and 0.4	0.5 and 0.6	0.7 and Above
Surgery	96 (59)	100 (4)	100 (31)	100 (18)	67 (6)
Desferrioxamine	77 (48)	50 (6)	77 (13)	89 (18)	73 (11)
Expectant	56 (25)	86 (7)	63 (8)	22 (9)	100 (1)

Note: Numbers in parentheses are numbers of cases in each group.

Of the surgically-treated group, 96 per cent. had resolved after 10 days' treatment compared with 77 per cent. of the desferrioxamine-treated group, and 56 per cent. of the expectantly-treated group. Surgery was completely successful in the treatment of all but the largest rust rings. Desferrioxamine appeared to be slightly more effective in the treatment of larger rust rings than of smaller ones. Expectant treatment was successful in the case of small rust rings, but its effectiveness decreased as the size of the ring increased.

The mean number of days of treatment until resolution of the rust ring is shown in Table III. Surgery was followed by resolution of the rust ring in a mean of 4.2 days. In this group 36 per cent. had more than one operation to remove the rust. The use of desferrioxamine was followed by resolution of the rust ring in a mean of 6.9 days. However, this mean includes the days to resolution after surgery following 10 days' desferrioxamine treatment in 21 per cent. of the group. Expectant treatment was followed by resolution of the rust ring in a mean of 8.5 days. However, this mean too includes the days to resolution following surgical removal of the rust after 10 days' expectant treatment in 20 per cent. of this group.

TABLE III

Method of Treatment	Mean Days to Resolution
Surgical	4.2
Desferrioxamine	6.9
Expectant	8.5

Note: Mean for Desferrioxamine and Expectant Treatment includes number of days to resolution after removal by surgery following 10 days' treatment in certain cases.

Thus the results of surgical removal of the rust ring as a primary procedure are better than the figures in Table III would appear to show.

Thirteen persons (27 per cent.) complained of soreness and stinging of the eyes after administration of the desferrioxamine ointment. One person in the desferrioxamine-treated group developed an allergic reaction, probably to gutt, hyoscine.

Few persons stayed away from work and there was no obvious disadvantage in this respect with any particular method of treatment. The final visual acuity was normal for the person concerned in all but two in whom the pupils were still dilated.

Conclusions

The results of the present survey show, using Yates's correction, that surgical treatment of iron-containing corneal rust rings was significantly better than treatment with 5 per cent. desferrioxamine ointment four times daily ($\chi^2 = 7.71$; $n = 1$; $P < 0.01$) or expectant treatment ($\chi^2 = 19.14$; $n = 1$; $P < 0.01$), and that treatment with 5 per cent. desferrioxamine ointment four times daily was not significantly better than expectant treatment ($\chi^2 = 2.54$; $n = 1$; $P > 0.05$).

Expectant treatment appeared more successful with small-sized rust rings and desferrioxamine with large rust rings.

Galin and others (1965) studied the effect of 10 per cent. desferrioxamine drops four times daily in removing experimentally-produced corneal rust stains in rabbits compared with expectant treatment of control eyes. The eyes treated with desferrioxamine healed much more quickly than the expectant group. Galin (1967) reported some success in the treatment of human corneal rust rings after injury by an iron-containing foreign body. Valvo (1967) reported the disappearance of human corneal rust rings within 4 days of treatment with 10 per cent. desferrioxamine ointment, and stated that a longer period was required before resolution in a group treated expectantly. The difference between the results of the present survey and those of Galin (1967) and Valvo (1967) may possibly be explained to some extent by the lower concentration of the desferrioxamine preparation used in the present study.*

Desferrioxamine may be of some use in the treatment of large corneal rust rings when skilled surgical attention is not available.

Cataracts have been reported in dogs given high doses of desferrioxamine in toxicity studies (Ciba Laboratories, 1965). Two cases have been reported of cortical cataracts, particularly in the posterior subcapsular area, in patients treated with systemic desferrioxamine because of excess blood iron, but both these patients were also receiving long-term systemic corticosteroid therapy (Ciba Laboratories, 1967). No lens changes were seen in the present series after the use of topical desferrioxamine.

Summary

Surgical removal of corneal rust rings after injury with an iron-containing foreign body was shown to be the treatment of choice. Treatment with 5 per cent. desferrioxamine ointment four times daily was less effective than surgical treatment. It was slightly more effective than expectant treatment, but this difference was not statistically significant. Desferrioxamine treatment of iron-containing foreign bodies may be useful if skilled surgical attention is not available.

* Ciba Laboratories now supply the desferrioxamine ointment in a 5 per cent. concentration which has been found to be less irritating to the eye.

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