

Effect of Zinc Sulfate on Tensile Strength of Incised Wounds : An Experimental Study

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Introduction

It has been reported in the literature that systemic administration of zinc sulfate promotes healing of granulating areas and of open excised wounds (Strain et al, 1960; Pories and Strain, 1966; Pories et al, 1967). Our experimental work on dogs (Gupta et al, 1970) supported these observations and the results (Fig. 1) encouraged us to follow it up with the present study.

Material and Method

Fifty albino rats weighing between 100-200 gms were divided into two groups of control and test. The test group received 100 mg/kg of zinc sulfate per day orally from day of operation.

Under pentothal anaesthesia, three incisions, about 4 cm in length were made in the skin, subcutaneous tissue and deep fascia of the ventral surface. The incisions

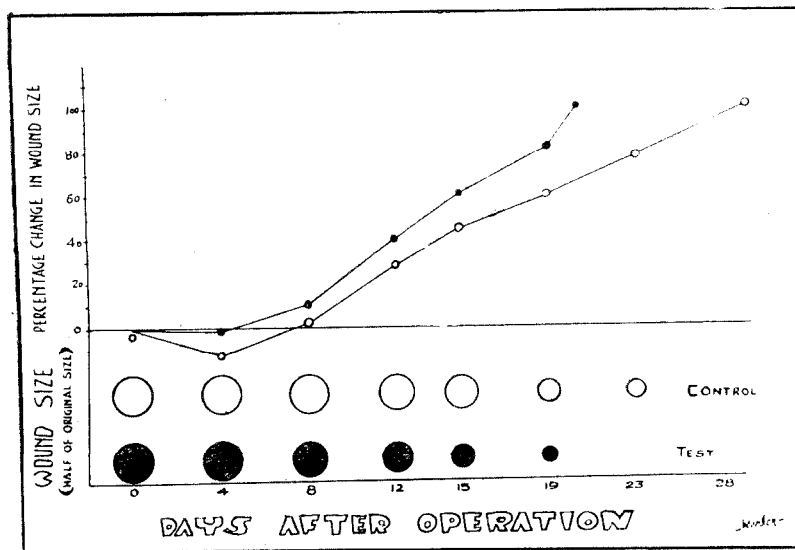


Fig. 1—Percentage change in the size of the wound on various days after operation in the control and the test groups.

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were then sutured with interrupted nylon sutures (Fig. 2). On 3rd, 5th, 7th and 9th post-operative days, sutures were removed, three strips of skin, subcutaneous tissue and deep fascia were excised, each bearing one incised wound in its centre. The following parameters were studied :

- (A) Tensile Strength : this was determined with a tensiometer.
 (B) Histopathology : the sections were

stained with :

- i) Hematoxylin and Eosin;
- ii) Verhoff's Strain; and
- iii) Von-Gieson's Strain.

Observations and Results

Tensile Strength

Table 1 shows the mean values of tensile strength of the two groups on corresponding days.

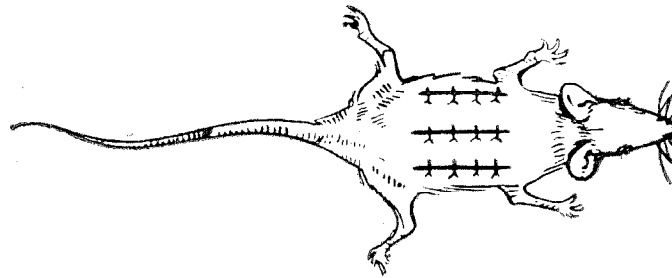


Fig. 2

Table 1

Post-operative Day	Group	(Mean T.S. gms)	S.D.	S.E.	t-value	p-value
3rd	—	—	—	—	—	—
5th	Control	89	12.37	6.18	1.98	0.10 Sig.
	Test	150	51.68	25.84		
7th	Control	175	75.32	30.74	0.076	0.10
	Test	179	100.48	35.51		
9th	Control	126	22.31	12.89	0.60	0.10
	Test	115	2.00	1.41		

On the 3rd post-operative day the wounds gave way on removal of sutures in both the groups. So further studies were not done in these.

On 5th post-operative day the mean value was considerably higher in the test group and this was statistically significant at p-value of 0.10.

On 7th post-operative day the mean value was higher in the test group but was statistically insignificant.

On 9th post-operative day the values were slightly lower in the test group and were statistically insignificant.

Histopathology

The H & E stained sections of 5th post-operative day from control animals show incomplete epithelisation, presence of inflammatory cells and comparative hyper-vascularity (Fig. 3a). The corresponding sections from the test group show almost complete epithelisation with a thin layer of epithelium (Fig. 3b).

The 7th day section (Fig. 4b) from the test group shows so complete a healing that it was difficult to identify the area of the incised wound; while in the corresponding section from the control group we can still see the epithelium in the process of

Fig. 3 a

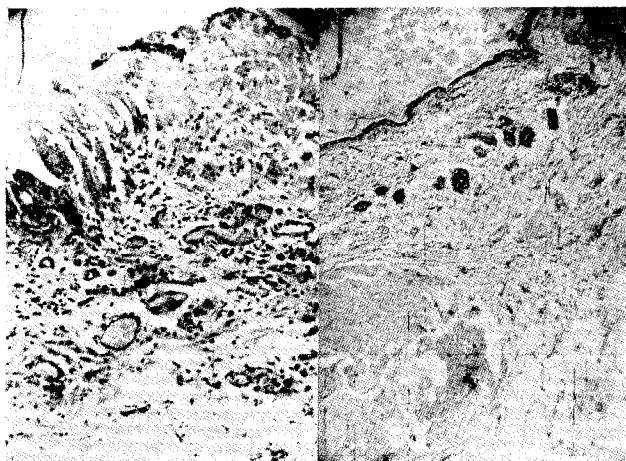


Fig. 3 b

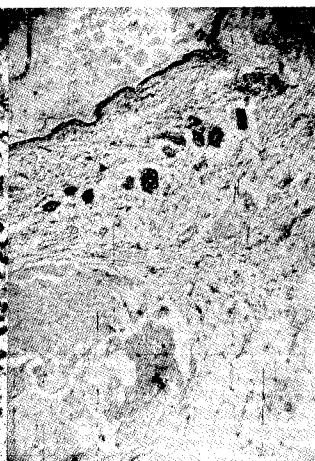


Fig. 4 a

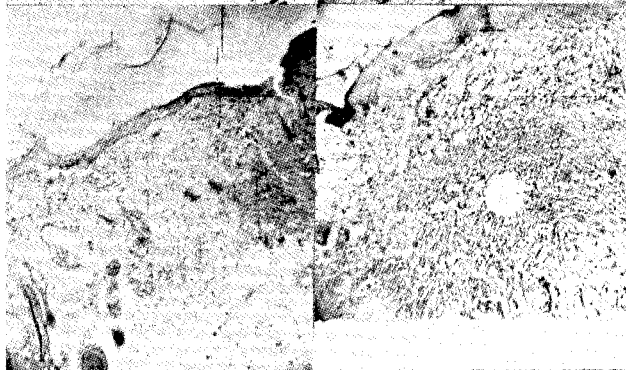


Fig. 4 b

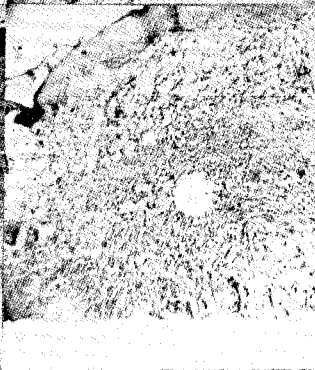


Fig. 3 Microscopic appearance on 5th post-operative day in the control group (a) and the Test group : (b) H & E.
Fig. 4—Microscopic appearance on 7th post-operative day in the control group (a) and the Test Group (b) H & E.

becoming normal indicating comparatively slower healing (Fig. 4a).

The ninth day sections from the two groups were almost identical.

In all the sections studied there was no appreciable difference in the various components of the healing tissue in the two groups.

The three senior pathologists who studied the histopathology slides separately in a double blind study gave identical comments. Their opinion was that "in view of the subjective nature of these observations it is difficult to come to any definite conclusions".

Correlation between Tensile Strength and Microscopic Appearances on Corresponding Days

It needs to be emphasised here that however minor the microscopic differences seen in the two groups, they did correlate well with the observations on the tensile strength e.g. on the 5th post-operative day the healing was better microscopically and the tensile strength too was significantly higher in the test group; on the 7th post-operative day microscopically, the healing was complete in the test group; but was still comparatively incomplete in the control group; the t.s. was also higher in the test group but the difference in the values in the two groups was statistically insignificant. On the 9th post-operative day the difference in the two groups was insignificant microscopically as well as in the t.s. values.

Discussion

A review of relevant literature (Sandstead and Shephard, 1967; O'Riain et al., 1968; Sandstead et al, 1970; Oberleas et al, 1971; Quarantillo, 1971; and Rahmat et al, 1974), revealed that our study differs from the other studies in three main aspects :

- a) Time of administration of supplemental zinc sulfate;
- b) Time of estimation of tensile strength; and
- c) Histopathological correlation with tensile strength

Time of Administration of Supplemental Zinc Sulfate

In this study supplemental zinc sulfate has been administered to normal rats, and not to zinc deficient rats, only in the post-operative period. Zinc has not been given in the pre-operative period.

Other workers (Sandstead & Shephard, 1967; Oberleas et al, 1971; Rahmat et al, 1974) have first produced zinc deficiency in normal rats and then carried out the experiments and compared the tensile strength between the zinc deficient rats and normal or pair fed control animals.

Sandstead et al. (1970) and Quarantillo (1971) have given supplemental zinc to normal rats as has been done in the present study but again there is notable difference in the sense that these workers have administered this additional zinc for one week before the operation and only Quarantillo (1971) has continued this additional

zinc in the post-operative period also

O'Riain et al. (1968) have given additional zinc to normal rats only in the postoperative period but the route of administration is intraperitoneal and not oral.

Time of Estimation of Tensile Strength

We have estimated tensile strength on 5th post-operative day also, in addition to 7th and 9th post-operative days; while all other workers have estimated tensile strength on 7th day, 10th, 12th or 14th post-operative day.

The conclusions of the various reported studies with additional zinc have been that there is no significant difference between the tensile strength in the two groups on 7th day and later. In the present study also we find no significant difference in the t.s. on 7th and 9th post-operative day in the two groups but there is certainly a significant difference on the 5th post-operative day.

Histopathological Correlation with Tensile Strength

Only Sandstead et al (1970) and Rahmat et al (1974) have reported a simultaneous histopathological correlation with tensile strength estimations; these studies were done on 12th day by the former and on 7th day by the latter authors. Their opinion was the same as in the present study i.e. in view of the subjective nature of these microscopic observations the differences in the two groups (Control and test) cannot be considered as significant. We

would reemphasize that however minor the microscopic differences seen in the two groups, they correlated well with the observations on t.s. on the corresponding days.

In view of these differences in the methodology of the present work and the reported literature on the subject our results are not strictly comparable to those of others.

Keeping in mind the results of our earlier work (Gupta et al, 1970) and those of the present study we would finally conclude that additional zinc sulfate has a beneficial effect, even in normal animals, on the healing process in its early phases, particularly in the first five days after operation; this effect is manifested as (i) an increase in the tensile strength in first five days; and (ii) as increased rate of healing of open wounds.

We suggest that in the early post-operative period there is either a deficiency of zinc, or an increased demand for zinc, at the site of incision, even in otherwise normal, healthy animals; if additional zinc is given in this early post-operative period then this deficiency of zinc is corrected or the additional demand for zinc is met with and a beneficial effect is the final outcome.

This additional zinc, to normal animals, need not be continued beyond the 7th post-operative day, as it has been shown that it has no effect, from 7th day onwards.

Regarding the mechanism of action of zinc there are many postulates none of which is confirmed yet. Since it has been shown in studies with radio active zinc

(Savlov et al, 1962) that this substance is preferentially concentrated in the healing tissues in the first five days after operation one can suggest that probably zinc acts biochemically and the effects are such that they are not discernible on microscopic examination.

It is concluded that zinc sulfate has a beneficial effect, in normal healthy animals, on the healing process in its early phases, manifested as an increase in t.s. in first five post-operative days. Histological correlation is presented and reviewed.

Summary

To evaluate the effect of oral administration of zinc sulfate on tensile strength of incised wounds experiments were conducted on 50 albino rats.

The results have been discussed and

the difference between the methodology of the present work and the reported literature pointed out.

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