Investigation on the Dosage/Efficacy Relationship of Iron Dextran in Veal Calves

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Summary

The efficacy of a single dose of 800 mg resp. 1600 mg iron in the form of an intramuscularly administrable iron(III)-dextran complex (Anaemex®, CAS 9004-66-4) has been tested. On 3 groups of 13 calves each, 0 ml (comparing group), 4 ml resp. 8 ml iron dextran 20 % have been applied. All calves received iron-containing food during the test period of 10 weeks. At the beginning of the therapy, 5 weeks and 8 weeks after application, the parameters: weight, hemoglobin, erythrocytes, hematocrit, mean corpuscular hemoglobin (MCH), MCH concentration, mean corpuscular volume, plasma protein, fibrinogen, leukocytes and serum iron were measured.

After 10 weeks the dead weight has been determined and the spleen of some calves tested histologically. The study shows that, by the administration of 1600 mg iron as a depot injection, a better growth results with the same quality of veal. The red-coloring of the veal was not significantly different from that of the comparing group. The histological findings show especially that the iron depots of the spleen were empty in all three groups and thereby in this collective no connection exists between the color of the veal and the tested dosage of iron dextran 20 %.

It is considered meaningful and economic to renounce in future the iron-containing food and in its place to apply intramuscular a single dose of 1600—2400 mg iron per calf.

The results are compared with a study on full term infants, which has shown that a intramuscular single dose of 150 mg of iron as iron dextran at birth affords a nutritional advantage in iron status for up to 15 months. This advantage is based on the fact that ferrous sulfate interacts with food stuffs and therefore the used iron fortified milk does not fulfill the requirement. From this point of view the problems of oral iron absorption and the efficacy of intramuscular iron dextran in the mentioned trial can be compared with this study.

Die Wirkung einer Einmaldosis von 800 mg bzw. 1600 mg Eisen in Form eines intramuskulär verabreichbaren, 20 % Eisen enthaltenden Eisen(III)-Dextran-Präparates (Anaemex®, CAS 9004-66-4) wurde an Kälbern untersucht. Den Tieren der drei Gruppen von je 13 Kälbern wurden 0 ml (Vergleichsgruppe), 4 ml bzw. 8 ml von Eisendextran 20 % appliziert. Alle Kälber erhielten während der Versuchsperiode von 10 Wochen eisenhaltiges Futter. Bei Therapiebeginn sowie 5 und 8 Wochen nach Applikation des Eisenpräparates wurden folgende Parameter bestimmt: Gewicht, Hämoglobin, Erythrozyten, Hämatokrit, durchschnittliches korpuskuläres Hämoglobin (MCH), MCH-Konzentration und durchschnittliches Korpuskularvolumen, Plasmaprotein, Fibrinogen, Leukozyten und Serumeisen.

Nach 10 Wochen wurde das Schlachtgewicht registriert und von einzelnen Kälbern die Milz histologisch untersucht. Die Studie zeigt, daß bei Applikation von 1600 mg Eisen als Depotinjektion ein besseres Wachstum resultiert, wobei die Fleischqualität erhalten bleibt. Die Rotfärbung des Fleisches unterschied sich nicht signifikant von derjenigen der Vergleichsgruppe. Die histologischen Untersuchungen zeigen, daß die Eisendepots der Milz in allen drei Gruppen leer waren und daß in diesem Kollektiv keine Beziehung zwischen der Rotfärbung des Fleisches und den verabreichten Testdosen besteht.

Es wird als sinnvoll und wirtschaftlich erachtet, zukünftig auf eisenhaltiges Futter zu verzichten und an dessen Stelle eine Einmaldosis von 1600 bis 2400 mg Eisen pro Kalb intramuskulär zu applizieren.

Die Resultate wurden einer Studie mit neugeborenen Kindern gegenübergestellt, welche zeigt, daß eine intramuskuläre Einmaldosis von 150 mg Eisen als Eisendextran bei Geburt einen ernährungsmäßigen Vorteil bezüglich des Eisenstatus bis zu einem Alter von 15 Monaten bringt. Dieser Vorteil ist auf die Tatsache zurückzuführen, daß Eisen(II)-sulphat mit Lebensmittelbestandteilen Interaktionen gibt, und daß deshalb die verwendete, mit Eisen(II)-

1. Introduction

The absorption of iron from foo
in every situation so extensively
not lead to anaemia and delay to
one hand, in the fact that the ab
gastro-intestinal tract lies in ger
of the dosage, and, on the other
food usually antibiotics like spi
are simultaneously given, whicl
tion of iron. This is especially
and antibiotics with phenolic g
addition, iron salts, in contrast
give interactions with food com
lems do not exist with iron com
plied intramuscularly or intrav
additional advantage that the al
is not only at about 20 %, as in ca
preparations, but at 90—100 %.

The dosage-efficacy relationshi
quality of veal and on the grow
better tested or respectively opt
administered preparations.

The problems of interaction of i
are well known in human medi
ommendation that iron(II)-salts
h before meals. But this recom
served in practice. Olivares et a
term infants that an intramuscu
of iron as iron dextran (CAS 90
a nutritional advantage in ir
months, when compared with a
group fed an iron fortified milk
as ferrous sulfate and 100 mg/l
caught up with the iron dextran
this point of view we can comp
iron absorption and the efficay
study with the study of Olivares

2. Methods

2.1. Randomization and test p

In a randomized study the influenc
dextran 20 % on the quality of veal
frequency of sickness and side effec
veal calves. Therefore three groups w
regard to race, weight and gender, h

2.2. Dosages of iron dextran 2 and iron requirement

The iron requirement which is caus
60 kg to about 170 kg can be calc
haemoglobin level of 10 g Hb/100 m
110 kg × 0.07 l/kg × 100 g Hb/l × 0.
The contribution of iron-enriched f
only 25 kg × 100 mg Fe/kg = 2500 m
Fe are absorbed because the absorp
20 %. In the next four weeks food wa

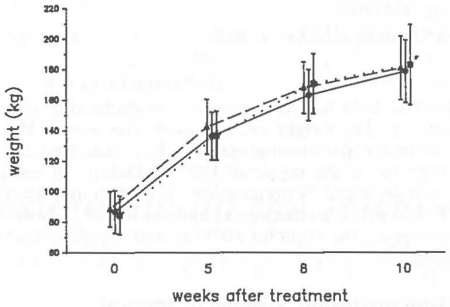


Fig. 1: Development of weight during the whole test period of 10 weeks. The mean values and the standard errors of the means (SEM) correspond to Table 1. ● Control, ▲ 4 ml iron dextran 20 %, ■ 8 ml iron dextran 20 %. These details apply also to Fig. 2—11.)

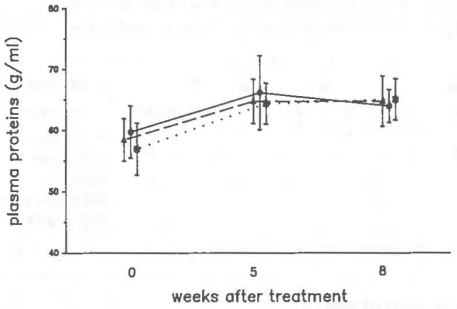


Fig. 2: Development of plasma protein during the first 8 weeks of the test period.

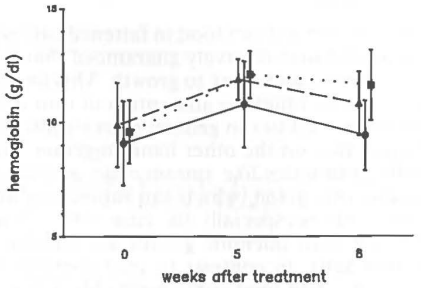


Fig. 3: Development of hemoglobin during the first 8 weeks of the test period.

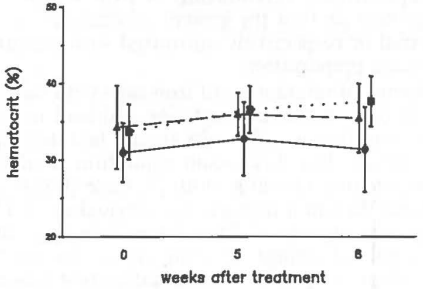


Fig. 4: Development of hematocrit during the first 8 weeks of the test period.

Table 1: Result of measurements of the 3 groups of calves at 0, 5, 8 and 10 weeks after application. Dosage: 0 ml, 4 ml resp. 8 ml of iron dextran 20 % for groups A, B and C. The mean values, the standard errors of the means (SEM) and the number of calves measured are given.

		0			5			8			10		
		Average	SEM	n	Average	SEM	n	Average	SEM	n	Average	SEM	n
Weight (kg)	A	86.69	14.02	13	136.38	15.73	13	163.23	16.79	13	178.85	19.72	13
	B	88.54	11.54	13	142.46	18.08	13	168.00	16.89	13	180.92	20.87	13
	C	84.54	12.64	13	136.69	16.13	13	170.69	19.62	13	183.08	25.23	13
Plasma protein (g/l)	A	59.85	4.26	13	66.17	6.05	12	64.00	2.69	13			
	B	58.54	3.46	13	64.77	3.62	13	64.77	4.10	13			
	C	57.00	4.24	11	64.38	3.34	13	65.08	3.36	13			
Hemoglobin (g/dl)	A	9.11	1.85	13	10.75	1.89	12	9.36	1.52	13			
	B	9.92	1.85	13	11.88	0.89	13	10.80	1.39	13			
	C	9.55	1.39	11	12.12	1.03	13	11.62	1.54	13			
Hematocrit (%)	A	31.00	3.86	13	32.75	4.78	12	31.38	5.53	13			
	B	34.31	5.43	13	36.00	2.80	13	35.54	4.50	13			
	C	33.73	3.60	11	36.62	3.08	13	37.69	3.29	13			
Iron (µl/l)	A	5.70	2.05	10	4.28	2.54	13	3.31	2.03	13			
	B	6.69	3.71	11	3.49	2.53	13	5.38	4.25	13			
	C	6.40	2.15	11	5.78	1.56	13	5.02	2.35	13			
Erythrocytes (10^6/µl)	A	9.08	1.26	13	10.28	0.96	12	9.96	1.08	13			
	B	9.69	1.35	13	10.44	0.84	13	10.63	1.48	13			
	C	9.77	1.00	11	10.65	0.92	13	10.77	0.63	13			

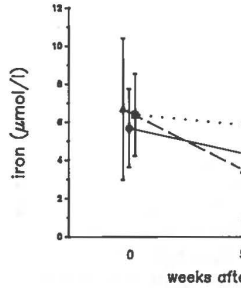


Fig. 5: Development of serum iron du
period.

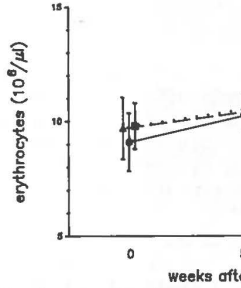


Fig. 6: Development of erythrocyte nur
test period.

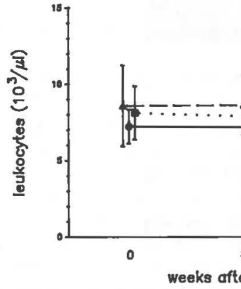
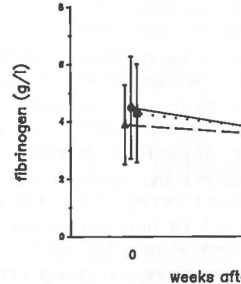


Fig. 7: Development of leukocyte num
test period.



ues. Similarly the value of group 2 of the 5th week is significantly different ($p < 0.01$) from the comparative value of group 3.

3.7. Erythrocytes

The volume of erythrocytes develops inconspicuously. The only significant differences are the following: After 5 weeks the increase in case of group 1 in comparison with the initial values ($p < 0.05$), after 8 weeks the increase in group 3 compared with the initial values ($p < 0.05$) and the difference from group 1 ($p < 0.01$).

3.8. Leukocytes

The behavior of the leukocyte numbers in blood is similar, i.e. decreasing little from week 0 to week 8. Only the value of group 2 at the 5th week is significantly different ($p < 0.05$) from the value at the 8th week and also from the value of the 5th week of group 1 ($p < 0.05$).

3.9. Fibrinogen

The behavior of the fibrinogen concentrations is inconspicuous with no differences among the groups. The numerical reductions during the 8 weeks are not significant.

3.10. MCH, MCHC and MCV

MCH (mean corpuscular hemoglobin concentration in pg) develops for group 1 and 2 through a maximum after 5 weeks ($p < 0.05$ in comparison after 8 weeks). For group 3 the values after 5 and 8 weeks are significantly ($p < 0.01$) higher than the starting values. The numeric maximum for group 3 is observed after 5 weeks. The differences between the groups are not significant, except the value of group 3 as compared to group 2 after 8 weeks ($p < 0.01$).

MCHC (mean corpuscular hemoglobin concentration in g/l) develops in case of all three groups in the same manner. The values after 5 weeks are significantly different ($p < 0.01$) from the initial values and the values after 8 weeks. There are no differences among the groups.

MCV (mean corpuscular volume in fl) diminishes in group 1, but not significantly. In group 2 and 3 the values remain constant.

3.11. Histological finding of spleen

Group 1: without iron dextran 20 %. Random sample test preparation of animal No. 302: practically no detectable iron.

Group 2: 4 ml iron dextran 20 % per animal. Random sample test preparation of animal No. 4003: in general little, as per rule single iron pigments with the following distribution:

red pulp	++
white pulp	(+)
marginal zone	++
capsule and trabecula	—

Group 3: 8 ml iron dextran 20 % per animal. Random sample test preparation of animal No. 4004: in general little, as per rule single iron pigments with the following distribution:

red pulp	++
white pulp	+
marginal zone	+++
capsule and trabecula	(+)

3.12. Local reactions

After the injection of iron dextran 20 % no local side reactions could be observed within the first three days after application. There was no coloration of the skin and also no swelling of the tissue. This is not astonishing, because all batches produced by Hausmann Laboratories have been tested for these parameters on piglets before releasing according to the technique published by Schmitz et al. [8].

4. Discussion

The efficacy of oral and parenterally applicable iron preparation on hematology, growth and the quality of the veal of calves has already been described by different authors [1, 2, 3, 5, 6, 9]. But the great problem lies in the fact that the quality of veal is judged differently from country to country and that consumers have different attitudes to this. The object of this study was to show that with a definite dosage the quality of veal, according to typical Swiss criteria, can be assessed as first class. Thereby mainly the criterion of color arises. The evaluation according to the parameter "red" veal in the different groups showed the following: group 1 without iron dextran 20 % showed 3 calves with "red" veal, group 2 with 4 ml iron dextran 20 % and group 3 with 8 ml iron dextran 20 % 5 calves each.

It should be noted that the color cannot be brought in connection with haemoglobin values and other blood parameters. This is also a result obtained by Disler [3]. The influence e.g. of the rate of bleeding to death is not to be overlooked. The histological findings are more pronounced. In non-treated animals practically no iron was found in the spleen with the histology test; in case of animals treated with 4 ml iron dextran 20 % traces of iron, and in those treated with 8 ml iron dextran 20% some more than traces of iron was detected. In both groups treated with iron dextran 20 % the distribution in the individual parts of the spleen does not show any clear difference. In general in the group treated with 8 ml only very little iron was histologically detectable.

From the measured values of haemoglobin, MCH and MCHC it results that after a maximum at 5 weeks, at 8 to 10 weeks, again a more distinctive anaemia can be observed. This is also shown histologically by the empty iron depots in the spleen in all the three groups.

Most interesting is the increase in weight of the group with 8 ml iron dextran 20 % (1600 mg iron). The higher increase of an average of 6.5 kg per calf means better growth. The plasma protein shows the same effect. Whereas the plasma protein increases in group 1 only by

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