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THE EFFECT OF CALCIUM-40 ON TIME DEPENDENT DISTRIBUTION, ACCUMULATION, LOSS AND BIOLOGICAL HALF-LIFE OF LEAD-210 IN VARIOUS ORGANS OF RATS*

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ABSTRACT

Injection of Pb-210 to the rats 12 hours after injection of Ca-40, caused, the highest value of biological half-life in tail and the lowest in skin. Ca-40 did not exert a significant effect on distribution of Pb-210 between the organs. The biological half-life of Pb-210 in total body of the animal was prolonged by the effect of Ca-40.

ÖZET

Ca-40 enjeksiyonundan 12 saat sonra sıçanlara yapılan Pb-210 enjeksiyonu, biyolojik yarı-ömür değerinin, kuyrukta en yüksek; deride ise en düşük bulunmasına neden olmuştur. Ca-40, Pb-210'un organlar arasındaki dağılımına anlamlı bir etki göstermemiştir. Pb-210'un total hayvan vücudundaki biyolojik yarı-ömrü, Ca-40'ın etkisiyle uzamıştır.

INTRODUCTION

The relationships between Ca-Pb and Pb-Ca have been the subject of investigations for many research works /1-10/. However the current literature does not cite the effect of calcium on the distribution, loss and accumulation of lead in various organs. For this reason, we have decided to investigate the effect of calcium on the distribution, accumulation and loss of lead in various organs and also in organs and whole body.

In this present investigation similar methods as previously mentioned were used /11/ except that an amount of calcium nitrate equivalent (0.0016 mg) to

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the lead nitrate solution was injected to the rat 12 hours prior to Pb-210 injection. The biological half-life in the whole body was determined by using 16 rats.

RESULTS

We can summarise the results obtained as follows;

1. Ca-40 when administered to the animals prior to Pb-210 increased the Pb-210 accumulation which was already found in excess, in the part between proximal end of femur and anterior intertrochanter line, the thinnest part of femur and tooth. On the other hand it decreased the accumulation of Pb-210 in some organs such as stomach, tongue, and pectoralis. Ca-40 did not exert an apparent effect on Pb-210 accumulation in kidney and large intestine, it appeared to regulate Pb-210 metabolism in heart, small intestine, liver, and lung (Table-1-3).

2. After the administration of Ca-40, the longest biological half-life of Pb-210 was found in the tail, 62.1±28.2 days and the shortest in the skin, 2.8±0.2 days (Table-4).

3. Ca-40 prolonged the total biological half-life of Pb-210 from 60.0±5.9 to 89.0±10.4 days (Fig. 1).

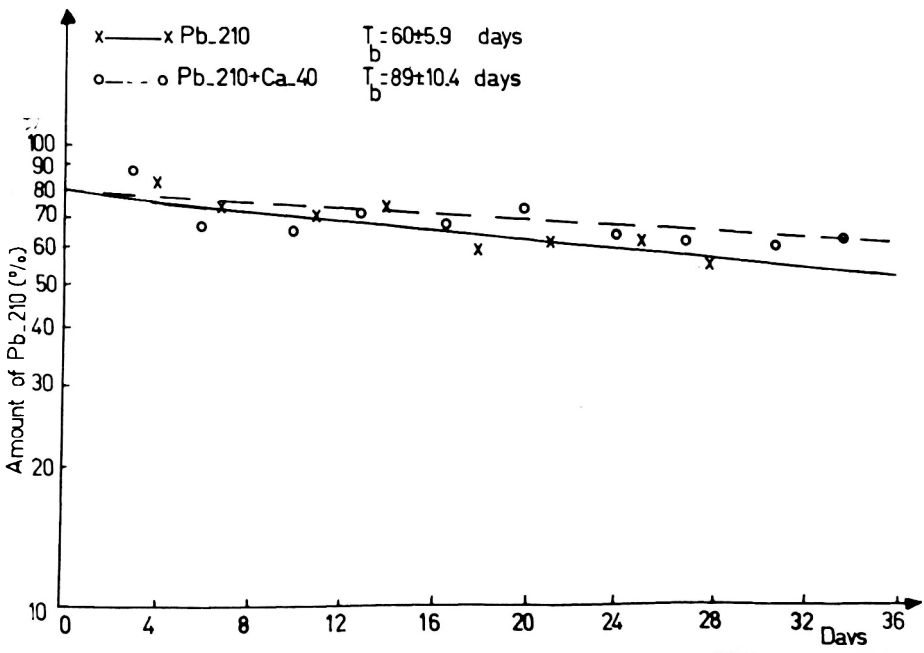

Fig. 1. The change in amount of Pb-210 in whole body with the effect of Ca-40.

TABLE-1. The Accumulation of Pb-210 in various organs with the effect of Ca-40.

Dissection period	1 week	2 weeks	3 weeks	4 weeks	5 weeks	Total
Individual number	8	9	8	7	9	41
Correction factor	7.6	7.2	6.9	6.5	6.2	
Organs	Af.co.(3)	Af.co.	Af.co.	Af.co.	Af.co.	Af.co.
1. Femur (1)	2247±16.9(4)	2277±16.0	1545±12.9	1154±21.5	1229±28.6	8452±44.6
2. Femur (2)	1386±14.9	2190±15.8	2139±17.2	1582±27.3	2222±38.9	9519±55.0
3. Tooth	1271±15.2	1627±12.7	2143±17.7	1507±35.2	1690±40.4	8238±59.8
4. Tail	283± 2.4	382± 3.0	337± 3.1	183± 3.3	275± 4.9	1470± 7.7
5. Kidney	986± 5.9	351± 3.0	250± 2.8	196± 6.1	164± 4.7	1947±10.5

(1) The part between proximal end of femur anterior intertrochanter line. (2) Thinnest part of femur. (3) Affinity coefficient. (4) Standart error.

TABLE-2. The decrease of Pb-210 in various organs with the effect of Ca-40.

Dissection period	1 week	2 weeks	3 weeks	4 weeks	5 weeks	Total
Individual number	8	9	8	7	9	41
Correction factor	7.6	7.2	6.9	6.5	6.2	
Organs	Af.co.	Af.co.	Af.co.	Af.co.	Af.co.	Af.co.
1. Biceps femoris	110± 7.3	59± 2.4	43± 2.9	98± 4.0	22± 9.4	332±13.1
2. Pectoralis	84± 6.2	20± 4.4	24± 6.4	29±21.6	9±13.8	166±27.1
3. Blood	663± 7.9	76± 4.8	39± 6.6	755±13.5	355±12.0	1888±21.3
4. Stomach	49± 1.2	10± 0.7	8± 1.0	88± 2.3	6± 3.3	161± 4.4
5. Spleen	27±13.5	28±15.8	112±17.9	240±59.7	37±24.9	444±70.1
6. Lung	27± 3.2	10± 3.0	17± 3.1	70± 4.8	24± 5.6	148± 9.1

TABLE-3. The variation of Pb-210 in various organs with the effect of Ca-40.

Dissection period	1 week	2 weeks	3 weeks	4 weeks	5 weeks
Individual number	8	9	8	7	9
Correction factor	7.6	7.2	6.9	6.5	6.2
Organs	Af.co.	Af.co.	Af.co.	Af.co.	Af.co.
1. Biceps brachii	144±12.8	19±10.5	19± 9.1	65±15.2	45±27.5
2. Tongue	18± 9.0	20±11.3	63±14.0	58±15.5	27±27.9
3. Heart	7± 5.0	17± 4.2	29± 4.9	36± 1.4	6± 8.1
4. Small intestine	33± 0.3	15± 0.3	17± 0.4	121± 4.1	9± 0.7
5. Large intestine	117± 0.9	30± 3.6	40± 0.8	104± 6.8	46±19.2
6. Liver	73± 0.5	22± 0.4	16± 0.3	123± 5.9	14± 0.7
7. Skin	60± 3.3	34± 2.0	39± 2.3	31± 4.0	1± 3.0
8. Brain	16± 1.2	14± 1.4	21± 1.6	82± 9.2	17± 4.8

CONCLUSION

The present work was performed in parallel with the previous one /11/ and its results are depic ted in Tables 1-3.

It is seen that the administration of Ca-40 enhance, the accumulation of Pb-210 in various organs, but this ratio drops gradually. The behaviour of different region of each organ regarding to Pb-210 accumulation is different. However, it is possible to divide these differences into three groups;

1. The organs in which the Pb-210 accumulation increases in the presence of Ca-40 (Table-1).

2. The organs in which the Pb-210 accumulation decreases in the presence of Ca-40 (Table-2).

3. The organs in which the Pb-210 accumulation is irregular in the presence of Ca-40 (Table-3).

It seems that in organs and tissues where Ca-40 occurs in a surplus, the accumulation of Pb-210 increases. The reason for this phenomenon may be the precipitation of lead as it occurs in the chemical reaction between some calcium compounds present in tissues and lead nitrate.

The interrelationships of calcium and lead are not understood clearly yet. Reciprocal experiments especially with radioactive calcium can enlighten some of the dark points in this subject.

TABLE-4. The biological half-life of lead-210 in various organs and it's accumulation's doubling time.

Element Half-life Organs	Ca - 40 + Pb - 210 T_b(1) (days)	T(2) (days)
1. Femur (5)	25.4± 2.3 (4)	-
2. Femur (6)	-	78.1±34.7
3. Tooth	-	109.4±60.6
4. Tail	62.1±28.2	-
5. Kidney	13.1± 1.5	-
6. Biceps femoris	18.2± 4.8	-
7. Biceps brachii	N.D (3)	N.D
8. Pectoralis	13.0± 2.3	-
9. Tongue	N.D	N.D
10. Heart	N.D	N.D
11. Blood	N.D	N.D
12. Stomach	N.D	N.D
13. Small intestine	N.D	N.D
14. Large intestine	N.D	N.D
15. Liver	N.D	N.D
16. Spleen	N.D	N.D
17. Skin	2.8±0.2	-
18. Lung	N.D	N.D
19. Brain	N.D	N.D

(1) Biological half-life. (2) Doubling time of lead-210's accumulation. (3) Not determined. (4) Standart error. (5) The part between proximal end of femur anterior intertrochanter line. (6) Thinnest part of femur.

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