BIOKINETICS AND DIAPLACENTAL TRANSFER OF J-131 IN RATS FED WITH EITHER STANDARD DIET OR IODINE DEFICIENT DIET

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INTRODUCTION

It was the aim of these studies to investigate the diaplacental transfer and distribution of iodine in the maternal and fetal organs of rats at different days of gestation, because there exist only limited quantitative information. The exact biokinetic data will serve for estimation of the hazard to the fetus from the release of these radionuclides by nuclear energy use and from its application in medicine (1,2,3,4). In particular we wanted to find out if there is a difference in uptake of J-131 into the maternal and fetal thyroid of female rats normally fed and rats fed with an iodine deficient diet (5).

METHODS

On day 17, 18, 19 and 20 of gestation 0.74 MBq of J-131 were injected intravenously into female rats. For the iodine deficient group the maternal animals were put on a diet a few days after birth that contains 41 ng iodine per gram food (standard diet 320 ng/g). The pregnant animals were sacrificed in groups of 5 animals each 0.5, 1, 2, 4, 8, 24 hours after administration of the radionuclide. From each female rat 5 fetuses were assayed for radioactivity in toto and additional 5 were dissected. From the dams and their fetuses blood and amniotic fluid were obtained and thyroid, stomach, liver and kidneys were dissected. After weighting, the radioactivity in the tissues was determined in a scintillation well-counter and the activity concentration was expressed in percent of the injected radioactivity per gram tissue.

RESULTS

Standard diet:

The fetal thyroid gland can first be dissected on day 17 of gestation. On this day its J-131 activity concentration is only 0.14% of the administered activity into the mothers blood circulation per gram tissue 8 hr after injection and is ever lower than the concentration in the fetal stomach. In the time intervall between 8 and 24 hr post injection the uptake of J-131 into the fetal thyroid increases by a factor of 4. This results are in agreement with autoradiographic studies that have demonstrated the starting function of the thyroid in tats on day 17 of gestation (6). The J-131 accumulation by the fetal gland raises very rapidly between day 17 and 20 of pregnancy (from 0.14%/g to 193%/g). The highest increase of activity concentration is found between day 17 and 18 of gestation and becomes less during the following days (7). Only on day 20 the J-131 concentration in the fetal thyroid gland equals the value of the analoqous maternal organ (193%/g and 198%/g). The J-131 activity of the fetal thyroid is only 0.44% of the whole fetal body radioactivity on day 17 raising to 35% until day 19. This value

decreases between day 19 and 20, as the fetal thyroid remains fairly constant in weight whereas the whole fetal body gains about 60% on weight.

But not only the fetal thyroid accumulates iodine the fetal stomach too shows a remarkable uptake of the nuclide (7). The activity concentration in the fetal stomach is higher than the concentration in the fetal blood during the whole investigation period (day 17-20).

Table 1: J-131-Activity Concentration in the Maternal Thyroid 2 and 8 hr p.i. (% inj. activity/g, mean ± S.D. from n=10)

Day of Gestation	2 hr p.i.		8 hr p.i.	
	standard diet	iodine deficient diet	standard diet	iodine deficient diet
17	133 ± 12	1136 ± 44	400 ± 26	1971 ± 132
18	193 ± 18	793 ± 71	436 ± 31	1690 ± 181
19	251 ± 27	854 ± 93	471 ± 28	1489 ± 162
20	105 ± 8	808 ± 67	198 ± 17	1476 ± 139

Iodine deficient diet:

A comparison between the J-131 concentration in maternal and fetal organs of the iodine deficient animal group and the organs of animals fed with standard diet shows significant differences. The activity concentration in the maternal thyroid of animals with iodine deficiency is much higher and the uptake is more rapid than into the thyroid gland of normally fed maternal animals (Fig. 1).

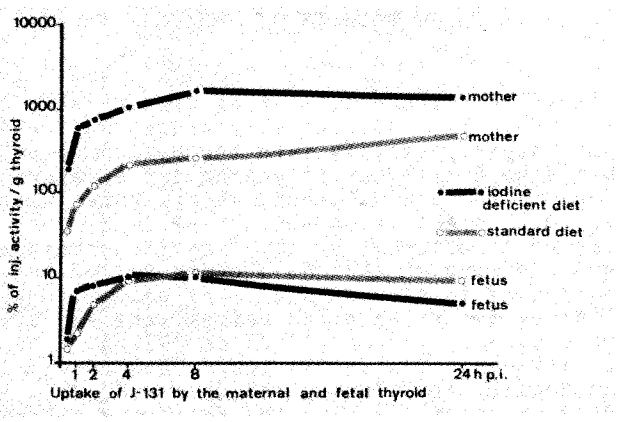

Fig. 1: Uptake of J-131 into the maternal and fetal thyroid of animals fed with iodine deficient diet (black circles) or with standard diet (white circles) on day 18 of gestation.

The results in Tab. 1 indicate that on all days of gestation investigated the J-131 accumulation by the maternal thyroid of the iodine deficient animals is increased at least 3 times compared with the animals fed with standard diet, the activity concentration in blood and all other maternal organs however beeing less.

For the fetal thyroid the accumulation of iodine after iodine deficient diet of the mothers is more rapid too, resulting in a higher activity concentration 2 hours after administration than in fetal thyroids of animals fed with standard diet. The concentrations 8 hours post injection however remain always lower in the fetal thyroids of the iodine deficient group (Fig. 1). Blood and all other fetal tissues of this animal group show a lower activity concentration 2 and 8 hours post injection. These results are represented in Fig. 2. The 2 upper graphs show the J-131 activity concentration in the whole fetal body for the two different fed animal groups on different days of gestation 2 and 8 hours post injection. The whole body activity concentration for the iodine deficient group (black bars) is always less than for the animal group after standard diet (white bars) 8 hours p.i..
The two lower graphs reflect the activity concentrations in the fetal thyroid gland. They show the higher 2-hr values for the iodine deficient group as well as the resulting lower concentrations for this animal group 8 hours after administration of the radionuclide.

The high J-131 uptake by the maternal thyroid after iodine deficient diet results in a reduced maternal blood level of iodine, leading to a decreased diaplacental transfer of the nuclide and therefore to a lower activity accumulation in the fetal thyroid.

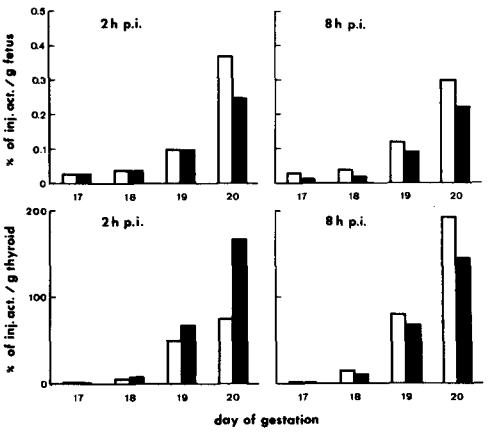

Fig. 2: Activity concentration (% inj. activity/g) in the whole fetus (upper graphs) and in the fetal thyroid (lower graphs) 2 and 8 hr p.i. for animals fed with iodine deficient diet (black bars) or standard diet (white bars)

CONCLUSION

The activity concentration of J-131 in the fetal thyroid is highly dependent on the stage of gestation. On day 17 the fetal thyroid starts its function with a slight accumulation of J-131, that rises by a factor of 1380 until day 20. In the fetal stomach an accumulation of J-131 could be determined too.

A comparison between the J-131 concentration in the maternal and fetal thyroid of iodine deficient females with that of animals fed with a standard diet showed a much higher and a much more rapid uptake of the nuclide into the thyroids of the iodine deficient dams. The uptake in the thyroid of their fetuses is also more rapid resulting in higher 2-hr values, the 8-and 24-hr activity concentrations however remain less than in the fetal thyroid of normally fed animals on all days of gestation.

The high J-131 uptake into the maternal thyroid of iodine deficient dams leads to a decreased diaplacental transfer of the nuclide. The resulting lower activity concentration in the fetal gland means a reduction of the absorbed dose for the fetal thyroid.

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