MAGNESIUM IN TUMOURS OF THE DOGS’ SKIN

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Abstract

The experiments were conducted in order to determine magnesium concentration in the tissue of malignant and non-malignant skin tumours in dogs in comparison to that in the skin of healthy dogs. Magnesium concentration was also determined in the blood serum. It was stated that magnesium concentration in malignant tumours was higher than in non-malignant tumours and in healthy dogs tissue. Magnesium concentration in the serum of dogs with malignant tumours was lower in comparison to the concentration of this element in the serum of dogs with non-malignant tumours and dogs from the control group. The relationship between skin tumour malignancy in dogs and magnesium concentration in the tissue and serum was discussed.

Key words: dog, magnesium, skin tumours.

The skin is an external coat of the body fulfilling important role in physiological actions, biochemical and immunological processes as well as in the processes of formation of free oxygenic radicals (3). It appears almost exclusively intracellularly. It is well-known that in the neoplasmic process magnesium metabolism is disturbed (6, 23). In the course of many neoplasmic processes magnesium concentration in erythrocytes and in the neoplasmic tissue increases. The estimation of magnesium level in erythrocytes has a prognostic value because magnesium increase in erythrocytes is the tumour progression coefficient, while the return of magnesium level to the norm proves the regression of the neoplasmic process (5, 23). In the neoplasmic tissue one can observe the increase in magnesium level in comparison to the normal tissue (25). The increase in magnesium level in the neoplasmic tissue and in erythrocytes causes a decrease in the content of the element in the blood plasma (13, 29).

The aim of this work was to determine magnesium concentration in the serum and skin of dogs with diagnosed skin and subcutis tumours.

Material and Methods

Magnesium concentration was determined in neoplasmic tissue of the skin and blood serum of 26 dogs of different races. The dogs were operated because of skin tumours in the Department and Animal Surgery Clinic of the Agricultural University in Lublin in 2000 – 2001. The age of dogs ranged from 6 to 14 years. Seventeen female and nine male dogs were operated. The material was taken from the dogs of the following races: German shepherd – 6, boxer – 6, doberman – 3, St. Bernard’s dog, schnauzer and rottweiler – 1 each and 10 dogs of mixed race. The tumours concerned the skin of different parts of the
body. In 8 cases the tumour appeared on the skin of limbs, 7 concerned the skin of the chest, 5 the skin of the stomach and 2 appeared on the skin of the tail, as well as in the neighbourhood of the anus and head.

After pharmacological calming the animal and before general anesthesia, blood was taken to an aseptic test-tube in order to receive serum for research. The neoplasmic skin and subcutis was taken after the surgical removal of the tumour. The segments of the tumour assigned for the examination were cleaned from blood clots with the stream of distilled water. The material was frozen at -18°C. It was kept in these conditions until the examination was made. The histopathologic diagnosis allowed to divide the dogs into groups with malignant and non-malignant tumours of the skin and subcutis. Seventeen tumours were defined as malignant and nine as non-malignant.

The control group was constituted by the dogs in the same age as in the group with tumours; they were in a good general condition and were operated because of other diseases than tumours. The material (blood and skin) from this group of dogs was taken in a similar way as previously.

In order to determine magnesium concentration in the tissue and blood serum the method of spectrophotometry of atomic absorption was applied (17). After weighing the tissue samples underwent the process of drying. Drying was conducted in quartz dishes at 80°C for 72 h. Then the samples were weighed again and underwent the process of mineralization by calcination at 450°C. Mineralized tissues were dissolved in spectrally clean concentrated hydrochloric acid (Merck), which was previously mixed with distilled doubly deionized water in ratio 1:1. The absorption for magnesium was determined in the spectrophotometer of atomic absorption (Pay-Unicam) after making a calibration curve.

In order to determine magnesium concentration in the blood serum, serum samples were placed in quartz melting pots and dried for 72 h at 80°C. After drying the material underwent the same procedure as in the case of tissue samples. The element was determined directly from the water phase in the same manner as described above.

Magnesium concentration in the neoplastic tissue, control tissue and serum of the dogs with and without tumours underwent a statistical analysis. For the examined and control groups the arithmetic mean and standard deviation were computed. For the determination of statistical significance t-Student test and C-Cochran-Cox test were used. It was accepted that an essential statistical difference equals $P \leq 0.05$, while $P > 0.05$ was accepted as statistically unimportant.

### Results

Magnesium concentration in tumour tissue of the skin and subcutis and in the control group is presented in Table 1.

Magnesium concentration in the tissue of malignant tumours fluctuated from 465 to 741 µg/g and was higher than in the tissue of non-malignant tumours, where it fluctuated from 342 to 692 µg/g. In comparison to magnesium concentration in the control tissue, where it varied from 352 to 473 µg/g, magnesium concentration in the tissue of malignant tumours was considerably higher.

Average magnesium concentration for the tissue of malignant tumours equaled $634 \pm 14$ µg/g and it was higher than that in the tissue of non-malignant tumours equaling $530 \pm 104$ µg/g and higher than in the control tissue, where it equaled $406 \pm 41.4$ µg/g. The difference between magnesium concentration in the tissue of malignant tumours and its concentration in the control tissue was statistically significant, while the difference between magnesium concentration in the tissue of non-malignant tumours of the skin and its concentration in the control tissue was statistically unimportant.

Magnesium concentration in the blood serum of dogs with tumours and in the control serum is presented in Table 2.

### Table 1

Magnesium concentration in skin and subcutis tumours

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Mg concentration from – to µg/g</th>
<th>$\bar{X} \pm SD$ µg/g</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant tumour</td>
<td>465 – 741</td>
<td>634 ± 14</td>
<td>$P &lt; 0.001^*$</td>
</tr>
<tr>
<td>Non-malignant tumour</td>
<td>342 – 692</td>
<td>530 ± 104</td>
<td>$P &gt; 0.05^*$</td>
</tr>
<tr>
<td>Control</td>
<td>352 – 473</td>
<td>406.2 ± 41.4</td>
<td></td>
</tr>
</tbody>
</table>

*Compared with control group.
Table 2
Magnesium concentration in the serum of dogs with tumours skin and subcutis

<table>
<thead>
<tr>
<th></th>
<th>Mg concentration from – to mmol/l</th>
<th>( \bar{X} \pm SD ) mmol/l</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant tumour</td>
<td>0.74 – 1.06</td>
<td>0.9 ± 0.1</td>
<td>P&gt;0.05*</td>
</tr>
<tr>
<td>Non-malignant tumour</td>
<td>0.78 – 1.12</td>
<td>0.9 ± 0.1</td>
<td>P&gt;0.05*</td>
</tr>
<tr>
<td>Control</td>
<td>0.78 – 1.12</td>
<td>1.0 ± 0.1</td>
<td></td>
</tr>
</tbody>
</table>

*Compared with control group.

Discussion

Human activity aiming at modernization of all areas of life involves unforeseeable consequences. In recent years a progressive degradation of the environment connected with the development of the industry was observed. It is closely connected with the increase in the number of people and animals with tumours. The destruction of the environment, especially in the areas of industrial city agglomerations has an essential influence on tumour development (1, 28). In most publications on tumour occurrence, still increasing number of animals with oncological problems is emphasized (1, 9, 14, 15, 26). Tumour prevention through the identification of risk factors and then their exclusion leads to a decrease in tumour prevalence. Animals with unpigmented skin have higher sensitivity to solar radiation, which at long-lasting and frequent exposure can result in neoplasia in the area of the skin (22, 31). In the organism bioelements play control functions, which are important for its proper functioning. They also have a certain significance in neoplasmic processes (2, 11, 32, 33).

In the presented study it was demonstrated that magnesium level in the neoplasmic tissue was considerably higher than that in the control tissue and the concentration of this element grew proportionally with the tumour malignancy. Magnesium level in the serum of dogs with tumours of the skin and mammary gland was slightly lower than its level in the control serum. The literature data referring to magnesium level in the neoplasmic tissue are in accordance with the results included in this paper (13, 24, 25). The decrease in magnesium level in the blood serum of dogs with tumours of the mammary gland and skin was accompanied with the accumulation of this element in the neoplasmic tissue, which can presumably induce tumour development. Own examinations as well as literature data show an essential increase in magnesium concentration and in the level of free amino acids in neoplasmic tissues.

Magnesium plays an important function in the biosynthesis of proteins which play a key role in cells multiplying intensity. Perhaps this is the cause of the increased need of this element in the neoplasmic tissue (8, 27). Magnesium level in the organism comes back to norm in patients undergoing chemotherapy or radiotherapy (13, 29). This confirms the role of magnesium in tissue metabolism. Changes in magnesium concentration can be used as an additional, essential coefficient enabling the estimation of tumour development.

References