SERUM OXIDATIVE STATUS
AND ADENOSINE DEAMINASE ACTIVITY
IN DOGS WITH TRANSMISSIBLE VENEREAL TUMOUR

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Abstract

Ten adult healthy bitches and 10 bitches with transmissible venereal tumour were investigated. Serum malondialdehyde, nitric oxide, antioxidant activity, vitamin C, retinol, β-carotene, adenosine deaminase activity, oestradiol-17β, progesterone, and cortisol were determined. Oxidative damage and increased adenosine deaminase activity were (P<0.05) demonstrated in bitches with the tumour compared to healthy bitches. In conclusion, antioxidant supplementation may be useful in the treatment of bitches with transmissible venereal tumour.

Key words: bitches, transmissible venereal tumour, oxidative status, adenosine deaminase.

Material and Methods

Ten adult healthy bitches (five Anatolian Shepherd dogs, three German Shepherd dogs, and two dogs of a mixed breed, 3-5-years-old, 15-34 kg b.w.) and ten bitches affected with TVT (three Anatolian Shepherd dogs, four German Shepherd dogs, one Collie, one Alaskan Husky, and one mixed breed dog, 4-8-years-old, 15-28 kg b.w.) were used in the investigation. Study protocol was approved by the Ethics Committee of the Veterinary Faculty. TVT was diagnosed by clinical (Fig. 1) and histological examinations (Fig. 2). Serum MDA (11), NO (20), AOA (17), vitamin C (VC)
(19), retinol, β-carotene (26), and ADA (13) levels were determined with an enzyme-linked immunosorbent assay/spectrophotometric reader (MWGt Lambda Scan 200, Bio-Tek Instruments, USA). Serum oestradiol-17β (Cobas Estradiol II assay; Roche Diagnostics), progesterone (Cobas progesterone II assay; Roche Diagnostics), and cortisol (Cobas cortizol assay; Roche Diagnostics) levels were measured by Moduler E170 (Roche Diagnostic). Haemogram was measured in anticoagulant venous blood samples by haemocell counter (Medonic-Biobak, Medonic AB, Sweden).

An independent t-test was used to make comparison of the data. Data are expressed as mean ±SEM. Significance was accepted at a level of P<0.05.

**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>Healthy group (n=10)</th>
<th>TVT group (n=10)</th>
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</thead>
<tbody>
<tr>
<td>MDA (nmol/mL)</td>
<td>1.512 ±0.137&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.347 ±0.174&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>NO (µmol/L)</td>
<td>6.489 ±0.497&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.952 ±0.461&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>AOA (mmol/L)</td>
<td>6.827 ±0.377&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.175 ±0.408&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>VC (mg/dl)</td>
<td>1.212 ±0.071&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.75 ±0.117&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Retinol (µg/L)</td>
<td>72.0 ±3.627&lt;sup&gt;a&lt;/sup&gt;</td>
<td>51.5 ±4.321&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Carotene (µg/L)</td>
<td>3.201 ±0.109</td>
<td>3.279 ±0.150</td>
</tr>
<tr>
<td>ADA (U/L)</td>
<td>190.0 ±14.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>302.9 ±15.90&lt;sup&gt;a&lt;/sup&gt;</td>
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TVT - transmissible venereal tumour; MDA – malondialdehyde; NO - nitric oxide; AOA - antioxidant activity.

VC - vitamin C; ADA - adenosine deaminase.

a, b; different letters in same line are statistically significant (P<0.05).

**Table 2**

<table>
<thead>
<tr>
<th></th>
<th>Healthy group (n=10)</th>
<th>TVT group (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC x10&lt;sup&gt;3&lt;/sup&gt;/µL</td>
<td>11.73 ±0.671</td>
<td>15.43 ±2.213</td>
</tr>
<tr>
<td>RBC x10&lt;sup&gt;6&lt;/sup&gt;/µL</td>
<td>8.04 ±0.237</td>
<td>8.03 ±0.502</td>
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<tr>
<td>HGB (g/dL)</td>
<td>16.29 ±0.473</td>
<td>16.1 ±0.977</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>57.73 ±1.782</td>
<td>57.15 ±3.428</td>
</tr>
<tr>
<td>PLT x10&lt;sup&gt;3&lt;/sup&gt;/µL</td>
<td>424.4 ±47.55</td>
<td>473.5 ±56.77</td>
</tr>
<tr>
<td>Oestradiol 17β (pg/mL)</td>
<td>39.11 ±13.23</td>
<td>21.77 ±6.475</td>
</tr>
<tr>
<td>Progesterone (ng/mL)</td>
<td>5.363 ±4.165</td>
<td>0.744 ±0.407</td>
</tr>
<tr>
<td>Cortisol (µg/dl)</td>
<td>3.394 ±0.783</td>
<td>4.427 ±0.773</td>
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</tbody>
</table>

TVT - transmissible venereal tumour; WBC - white blood cell; RBC - red blood cell; HGB – haemoglobin.

PCV - packed cell volume; PLT - platelet.

There is no statistical significance in the same line (P>0.05).
Results

Serum oxidative status and ADA levels in healthy bitches and bitches with TVT are shown in Table 1. Blood haemogram and serum hormone levels in the bitches are shown in Table 2. As can be seen from the Table 1, increased MDA, NO, VC, and ADA levels (P<0.05), and decreased AOA and retinol levels (P<0.05) were found in bitches with TVT compared to healthy bitches.

Discussion

TVT, a sexually-transmitted tumour, occurs especially in female adult dogs (10). Superior oxidative damage develops in tumour tissue (23). In this research, MDA and VC levels significantly increased, while AOA and retinol levels significantly decreased, in bitches with TVT compared to healthy bitches. Increased MDA levels, the end-product of lipid peroxidation occurring under oxidative stress, and decreased AOA and retinol levels, were reported previously in different cancer types of humans (2, 4, 16). Higher MDA level may reflect oxidative damage in bitches with TVT because leukocytes infiltrate to malignant tissues and secrete ROS (21). Low AOA and retinol levels and major non-enzymatic antioxidant, may be due to increased propensity to scavenge ROS. In this research, higher VC level was determined in bitches with TVT compared to healthy bitches. Although low VC levels were generally determined in human cancer patients (4, 7), unchanged VC level was reported in dogs with lymphoma compared to healthy dogs (27). This result may depend on the difference in the diets between healthy and cancer patients.

NO is a small, unstable gas and is produced by different NO synthase enzyme (NOS) types. A’ dose-dependent relationship between NO and tumour response is observed, and enhanced NO level was noted in tumour tissues (9). In this research, higher NO level was observed in bitches with TVT. Increased NO production is well documented as an essential step initiating neoplastic transformation. Both tumour and immune cells can produce NO due to induced expression of inducible NOS. However, peroxynitrite derived from NO causes DNA damage and lipid peroxidation (6, 21).

In this study, serum ADA activities in bitches with TVT were significantly higher than in healthy bitches. Although the activity of ADA was usually found to increase in cancer patients (1, 23), it was reduced or unchanged in some types of cancer (15, 30). It was reported that increased ADA activity may be due to the increased DNA turnover and enhanced inflammation in cancer (23). However, increased serum ADA activity may also originate from sources such as monocyte-macrophages other than TVT tissues because of enhanced inflammation.

Oxidative stress may cause the production of granulosa cell steroid hormones, which are a significant predictor of ovarian response (3). Although oxidative stress was determined in bitches with TVT, serum oestradiol-17β and progesterone levels were the same in bitches with TVT and healthy bitches in this study.

The presented results indicate that oxidative damage and increased ADA activity occur in bitches with TVT, and antioxidant supplementation may be useful in the classical treatment of TVT in dogs.

References


