EFFECTS OF XYLAZINE ON THYROID HORMONES, INSULIN, AND GLUCAGON IN DOGS

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Abstract

In this study, the effects of xylazine on serum levels of triiodothyronine (T3), tetraiodothyronine (T4), insulin (INS), and glucagon (GN) in dogs were investigated. The dogs before injection were used as control group (0 h). The dogs were injected with xylazine at 3 mg/kg, then blood was collected from the peripheral veins at 0.5, 2, 8, 24, 48, 72, and 120 h after the injection. Serum T3, T4, INS, and GN were measured by ELISA. The results revealed that the T3 level decreased in serum 0.5 h after the injection (P<0.05), while the change in T4 was not significant. The secretion of INS increased 8 h after the injection (P<0.05). The GN level increased 2 h and 8 h after the injection (P<0.05). However, all of these changes returned to the norm after 24 h.

Key words: dog, xylazine, triiodothyronine, tetraiodothyronine, insulin, glucagon.

As a result of Chinese economic development, the number of animals used as pets, and for experiments has increased along with the rapid development of animal husbandry. The new compound anaesthetics were developed, which showed ease of application, suitability, and fewer complications (4, 9). Some experimental research has shown that anaesthesia could result in changes of the immune and endocrine functions (5). Xylazine has been used as a components of a variety of anaesthetics (2, 8, 10), but there are limited reports on its effects on endocrine function when injected alone. Triiodothyronine (T3), tetraiodothyronine (T4), insulin (INS), and glucagon (GN) are important hormones in animals. Thus this investigation focuses on the effects of xylazine on T3, T4, INS, and GN.

Material and Methods

A total of 12 healthy dogs in good nutritional status were selected from a nursery in Harbin (1-2 years old, 19-21 kg). They were maintained under the same conditions. Routine treatment included immunisation (against canine distemper, infective hepatitis, parvovirus, parainfluenza) and de-worming.

A volume of 2 ml of blood was collected from the peripheral veins before the treatment (0 h, control), and then the dogs were injected intramuscularly with 3 mg/kg of xylazine. Two millitres of venous blood was collected 0.5, 2, 8, 24, 48, 72, and 120 h after the injection. The blood was centrifuged at 3,500 rpm for 10 min, and the collected serum was stored at -20°C. Serum concentrations of T3, T4, INS, and GN were measured using ELISA kits (Shanghai Hufeng Chemical Industry Co., Ltd, China) according to the manufacturer’s instructions. The measurements was performed in a Power Wave XS Universal Microplate Spectrophotometer (BIO-TEK Instruments Inc., USA).

All the experimental procedures were approved by the Local Ethics Committee for Animal Experiments. The results were analysed by variance analysis. Experimental data were expressed as the mean ± standard deviation (X ± SD). SAS for Windows 6.12 was used for statistical analysis of experimental data. The differences between control values and those obtained after treatment were considered significant at P<0.05.

Results

The results of serum concentration of T3, T4, INS, and GN before and after injection of xylazine were shown in Table 1. As can be seen from the Table, T3 and T4 concentrations achieved the minimum value at 0.5 h after injection, INS at 2 h, and GN at 72 h. The maximum value of T3 and T4 concentrations were detected at 0 h (before injection), INS, GN achieved the maximum value at 8 h, at 2 h after injection respectively. As shown in Fig. 1, there was a sharp decrease in T3 concentration at 0.5 h and 2 h after injection (P<0.05). From 2 h until 120 h, there was a steady rise in T3, but at the 8 h point, the T3 concentration returned to the norm.
Fig. 2 shows that there was a sharp decrease in T₄ concentration from 0 to 0.5 h, but analysis of variance indicates that the difference was not significant. Fig. 3 shows that the INS concentration compared with the control group increased 8 h after the injection (P<0.05). As shown in Fig. 4, the GN serum levels at 2 h and 8 h in treated dogs were higher than in the controls.

### Table 1

<table>
<thead>
<tr>
<th>Time after injection (h)</th>
<th>T₃ (ng/mL)</th>
<th>T₄ (ng/mL)</th>
<th>INS (uIU/mL)</th>
<th>GN (pg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.750±0.089³⁴⁵⁶⁷</td>
<td>25.303±2.030</td>
<td>5.556±0.671³⁴⁵⁶⁷</td>
<td>96.099±12.412³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>0.5</td>
<td>0.596±0.074³⁴⁵⁶⁷</td>
<td>21.521±4.47³⁴⁵⁶⁷</td>
<td>5.184±0.839³⁴⁵⁶⁷</td>
<td>104.983±18.788³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>2</td>
<td>0.615±0.071³⁴⁵⁶⁷</td>
<td>21.659±3.603</td>
<td>5.128±0.125³⁴⁵⁶⁷</td>
<td>132.143±18.625³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>8</td>
<td>0.700±0.127³⁴⁵⁶⁷</td>
<td>23.551±3.669</td>
<td>6.297±0.401³⁴⁵⁶⁷</td>
<td>127.254±11.573³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>24</td>
<td>0.695±0.121³⁴⁵⁶⁷</td>
<td>23.942±3.87³⁴⁵⁶⁷</td>
<td>5.435±0.374³⁴⁵⁶⁷</td>
<td>103.700±19.306³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>48</td>
<td>0.727±0.083³⁴⁵⁶⁷</td>
<td>23.984±3.461</td>
<td>5.550±0.607³⁴⁵⁶⁷</td>
<td>100.800±13.070³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>72</td>
<td>0.726±0.150³⁴⁵⁶⁷</td>
<td>24.875±1.544</td>
<td>5.509±0.539³⁴⁵⁶⁷</td>
<td>98.762±17.189³⁴⁵⁶⁷</td>
</tr>
<tr>
<td>120</td>
<td>0.725±0.104³⁴⁵⁶⁷</td>
<td>25.168±1.484</td>
<td>5.585±0.572³⁴⁵⁶⁷</td>
<td>98.766±10.341³⁴⁵⁶⁷</td>
</tr>
</tbody>
</table>

The different lower cases of the superscript stand for the significant difference of the data obtained from the two groups' at P<0.01; the different upper cases of the superscript mean that the data of the two groups were significantly different at P<0.05.
Discussion

T3, insulin, and glucagon can promote the cell’s metabolism of sugar, fat, and protein, and accelerate the growth of cells. Anaesthetics influence these endocrine hormones in various ways, and the changes in endocrine hormones could influence postoperative healing of the tesis vulnus, general body recovery, and even immune function.

Past research has shown that the effect of anaesthesia on the body thyroid hormones varies. For example, one study showed that a major operation could influence thyroid hormone secretion causing “temporary hypocalcaemic syndrome” (1, 7). It has been reported that ether anaesthesia could cause a decrease in the levels of serum T3 and T4 over time (3). Our results showed that the level of serum T3 0.5 h after anaesthetic administration was lower than that of the control group, but returned to a normal level 8 h after the start of anaesthesia. The temporary decline of thyroid hormone could be caused by the xylazine intramuscular injection. Reduction in thyroid hormone concentrations may be due to the inhibition of adrenergic nerve by xylazine, as it is known to cause a decrease in T3 secretion and 5'-deiodinase activity in tissues. At the same time, because the body temperature drops, and the heart rate and breathing become slow, compensatory consumption of T3 activity increases. Chen Wang (11) has confirmed these observations. However, there are different views on the influence of anaesthesia on thyroid hormones. For example, it has been reported (12) that common anaesthetics could cause changes in plasma thyroid hormone levels, but the most significant influence on thyroid hormones was caused by enflurane, as it could increase both free and total thyroxine in a short period.

In this study, changes in insulin and glucagon may be caused by a reduction of blood sugar. Xylazine can inhibit secretion of adrenephrin, arterenol, and thyroid hormones, so glycogenolysis and gluconegenesis induced by these hormones decrease, and hence the levels of blood sugar are reduced. Maraisal (6) found that the xylazine compound fentanyl could act on β-islet cells directly and inhibit the secretion of insulin. In this study, we found that at the beginning of injection, the insulin level first decreased and then increased, as the action of xylazine had been reduced.

Injection of xylazine can decrease the plasma concentration of T3 and increase significantly the plasma concentration of INS and GN. These findings are very important for the carrying out of surgery, and may contribute to understanding the role of xylazine in the combined anesthesia.

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References