Developmental EEG of the Beagle Dog under Xylazine Sedation

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ABSTRACT. Developmental EEGs of beagle dogs under xylazine sedation were investigated. EEGs could be recorded stably for about 60 min. Predominant EEG patterns under xylazine sedation were quite similar to those of natural middle and deep sleep stages (younger than 15 weeks) or natural light sleep stage (older than 16 weeks). KEY WORDS: dog, EEG, xylazine.

Electroencephalography has been widely used in diagnosis of neurologic disorders in small animals. However, in order to obtain reliable electroencephalogram (EEG), it is important to eliminate muscle activity and movement artifacts as well as to know the age and the level of consciousness of the animals [14]. Though the recording of EEG under relaxed condition is more ideal, it is very difficult to record without chemical restraints. Therefore, most of the studies were undertaken under anesthesia such as barbiturates [1, 7–9], halothane [6], and ketamine [2, 12], or skeletal muscle relaxant like gallamine triethiodide [5]. As those chemical agents may change intact EEG patterns, the EEGs of normal animals under the same chemical restraint must be used as a control to evaluate the abnormal ones.

Xylazine is a nonnarcotic analgesic sedative, which has been used as a very safe drug for many kinds of examinations, treatments, and even minor operations in aged dogs and cats [3, 4, 10, 11, 13, 15].

In this paper, EEGs were recorded under xylazine sedation in developmental and adult beagle dogs to investigate the effects of xylazine on the normal EEG patterns, and to obtain a normal map to evaluate neurologic disorders.

Fifteen beagle dogs aged from birth to 48 weeks and 12 adult beagle dogs which did not show any neurologic abnormalities were used for EEG recordings under xylazine sedation. The total number of dogs investigated in each age is shown in Table 1. Dogs were given 0.05 mg/kg of atropine sulfate subcutaneously before subcutaneous injection of 2 mg/kg of xylazine. EEG recording was started 10 to 15 min after xylazine injection, when the dogs were all sedated. All dogs except younger than 2 weeks of age were loosely bound their limbs to the examination table. The EEG recording was carried out as previously

<table>
<thead>
<tr>
<th>Age in weeks</th>
<th>Number of dogs</th>
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<td>0–1</td>
<td>4</td>
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<tr>
<td>2</td>
<td>4</td>
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<td>3–5</td>
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<td>6–10</td>
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<td>11–15</td>
<td>8</td>
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<td>16–30</td>
<td>23</td>
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<tr>
<td>31–48</td>
<td>7</td>
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<tr>
<td>Adult</td>
<td>12</td>
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Table 1. Total number of beagle dogs investigated in each age

reported [16]. The copper wire electrodes were set at the left and right fronto-parietal area (LF, RF), and the left and right occipital area (LO, RO) under the scalp, and a reference and a ground electrode was set at the rhinal bone (R) and the neck respectively. A respiration transducer (resistance plethysmography of the thoracic type) was set around the chest. EEGs were recorded as monopolar leads (LF-R, RF-R, LO-R, RO-R) by an 8-channel polygraph at a speed of 2.5 cm/sec. The time constant was 0.3 sec and the gain on the amplifier was set at 100 µV/cm for all recordings.

All dogs were well sedated and muscle and movement artifacts were hardly recorded from about 10 min after xylazine injection. Bradycardia was seen in some cases, but atrioventricular block was not recorded in any cases. EEGs could be recorded stably about 60 min before the dogs started to move again. Recovery from sedation was mostly good and no other side effects were seen thereafter.

EEG patterns under xylazine sedation could be classified visually into 3 stages except the puppies younger than 2 weeks of age. The stage 1 appeared at the beginning phase of sedation, at which dogs still could move by stimulations such as pinching, clapping, or touching on the eyelids. EEG patterns of this stage were characterized by slow waves with the frequencies of 6–8 Hz and the amplitudes of 30–70 µV.

Stage 2 appeared after stage 1, and in this stage, dogs were completely sedated with little response to stimulations. EEG patterns of this stage were characterized by slower waves with 3–5 Hz and 50–200 µV than those in stage 1.

EEG patterns of stage 3, in which dogs were also sedated, were characterized by rhythmic waves (3–7 Hz, 10–50 µV) and low amplitude waves (5–10 Hz, 10–20 µV).

EEGs under xylazine sedation in the dog of each age were described below according to this classification.

From birth through the 1st week of age, a little cortical activities with random bursts (5–15 Hz, 25 µV) were seen constantly. At the 2nd week of age, they changed dramatically, in which the similar pattern to those of stage 2 with lower amplitudes (20–40 µV) first appeared and lasted for 20 min. But those of the 1st week were seen during the other part of recordings.

From the 3rd through the 5th of age, 3 stages could be first distinguished clearly (Fig. 1). EEGs of stage 1 appeared 10 min after xylazine injection and lasted for 10 min. Then EEGs of stage 2 (1–5 Hz, 50–100 µV) lasted for about 30 min, followed constantly by rhythmic waves of stage 3.

As they grew older, differences of these 3 stages became recognizable more clearly.
EEG OF THE BEAGLE DOG UNDER XYLAZINE SEDATION

6 WEEKS

Fig. 2. EEGs of the beagle dog at the 6th week of age under xylazine sedation.

12 WEEKS

Fig. 3. EEGs of the beagle dog at the 12th week of age under xylazine sedation.

20 WEEKS

Fig. 4. EEGs of the beagle dog at the 20th week of age under xylazine sedation.
ADULT

<table>
<thead>
<tr>
<th>LF-R</th>
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<tbody>
<tr>
<td>RF-R</td>
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<td>LO-R</td>
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<tr>
<td>RO-R</td>
<td>50 µV</td>
<td>1 SEC</td>
</tr>
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Fig. 5. EEGs of the adult beagle dog under xylazine sedation.

(FIG. 2). Though the duration of stage 1 was comparably constant (10 min), that of stage 2 increased and reached the longest (about 40 min) in the dog of about 10th week of age. At this age, EEG patterns of stage 2 were characterized by slow waves with high amplitudes (3–4 Hz, 100–150 µV) as well as activities with low amplitudes (14 Hz, 30–50 µV).

From 11th through 15th week of age, the amplitudes of EEGs of stage 2 showed highest (200 µV) among waves of any other age (FIG. 3). On the other hand, the duration of stage 2 started to decrease after this age. Instead, EEGs of stage 3 appeared for longer period.

After 16th week of age, the duration of stage 2 became quite short (5–10 min) and the amplitudes decreased gradually, whereas the EEGs of stage 3 were predominant under xylazine sedation (FIG. 4). EEGs of stage 1 were mostly slow waves (6–8 Hz, 30–70 µV) and lasted for about 10 min.

After 30th week of age, EEG patterns were very similar to those of adult dogs, in which the waves of stage 3 (7–13 Hz, 10–30 µV) were stably recorded for about 50 min. And the differences of the waves between stage 1 and stage 2 were sometimes not distinguished clearly (FIG. 5).

Comparing these results with developmental EEG of the beagle dog previously reported [16], EEGs of stage 2 under xylazine sedation, which were predominant waves in the dog younger than 15 weeks of age, were quite similar to those of natural middle and deep sleep stages in the dog of the same age. Also EEGs of stage 3 under xylazine sedation, which were predominant waves in the dog older than 16 weeks of age and adult dogs, were quite similar to those of natural light sleep stage.

Also very similar changes of the amplitudes were observed in the dog both with and without xylazine sedation. The amplitudes started to increase from 2 weeks of age and reached to the highest at about 12 weeks of age, then decreased thereafter.

These results may suggest that xylazine sedation can be used as a very safe and useful chemical restraint for electroencephalography in the dog.

REFERENCES

要約

成長期ビーグル犬におけるキシラジン鎮静下の脳波（短報）：唐来克弘・仙波裕之・佐々木伸雄・德力幹彦21・大橋文人・竹内啓・臼井和哉 (東京大学農学部家畜外科学教室，11家畜環境生理学教室) ——正式な成長期ビーグル犬におけるキシラジン鎮静下の脳波を、観察によって検討した。15週齢以下では、自然睡眠の中程度ないし深睡眠期に類似する脳波が多く出現し、16週齢以上では、軽睡眠期と類似する脳波が多く出現した。また、キシラジン投与に伴う副作用は少なく、アーティファクトの混入のない脳波が安定して得られたことから、本法は犬の脳波検査に有用であると思われた。