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Fish physiology

CARDIO AND RESPIRATORY RESPONSES IN EEL, *ANGUILLA ANGUILLA* L.
DURING EXPOSURE TO DIAZEPAM

WPLYW DIAZEPAMU NA SERCOWE I ODDECHOWE REAKCJE WĘGORZA
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The effects of 0.5 mg/l diazepam on the cardio and respiratory system of the eel was studied. It has been confirmed that the major effect of diazepam appeared during the first 30 minutes, there after the bioelectrical activity of the heart and respiratory rate tend to return to their normal, except for a slight disturbance in the ventricular cardiac muscle repolarization.

INTRODUCTION

Diazepam was found to have anticonvulsant properties and it is recommended for a wide use in veterinary and fisheries practice (Fitko et al. 1975; Węgrzynowicz et al. 1981). The rapid sedative and anticonvulsant properties of diazepam was suggested to be depended upon the action of the drug on the nerve cell bodies as indicated by the early and high accumulation of diazepam in grey matter (Vieth et al. 1968; Marselli et al. 1973). Although there are many reports on the physiological effects of diazepam (Banna, 1970; Narahashi et al. 1971; Taylor and Laverty, 1973) yet no information have been conducted to relate diazepam effects on the bioelectrical activity of the heart and ventilation rate. Therefore, the main objective of this study is to assess the effects of diazepam on the cardiovascular-respiratory system of the eel fish.

MATERIALS AND METHODS

The eel, *Anguilla anguilla* L., weighing 177.1 ± 33.9 g and measuring 45.2 ± 2.9 cm were brought to the laboratory and acclimated under appropriate experimental condi-

tions. Fish ECG were obtained with the method of Labat (1966) using a single channel CGK-301 electrocardiographic apparatus and CMK-405 cardiomonitor. Recording of the ECG began after returning the fish with the electrodes to normal conditions at paper speed 25 mm/second. The voltage of the waves was measured along the vertical lines and is expressed in mv. The heart rate per minute was calculated from the ECG,

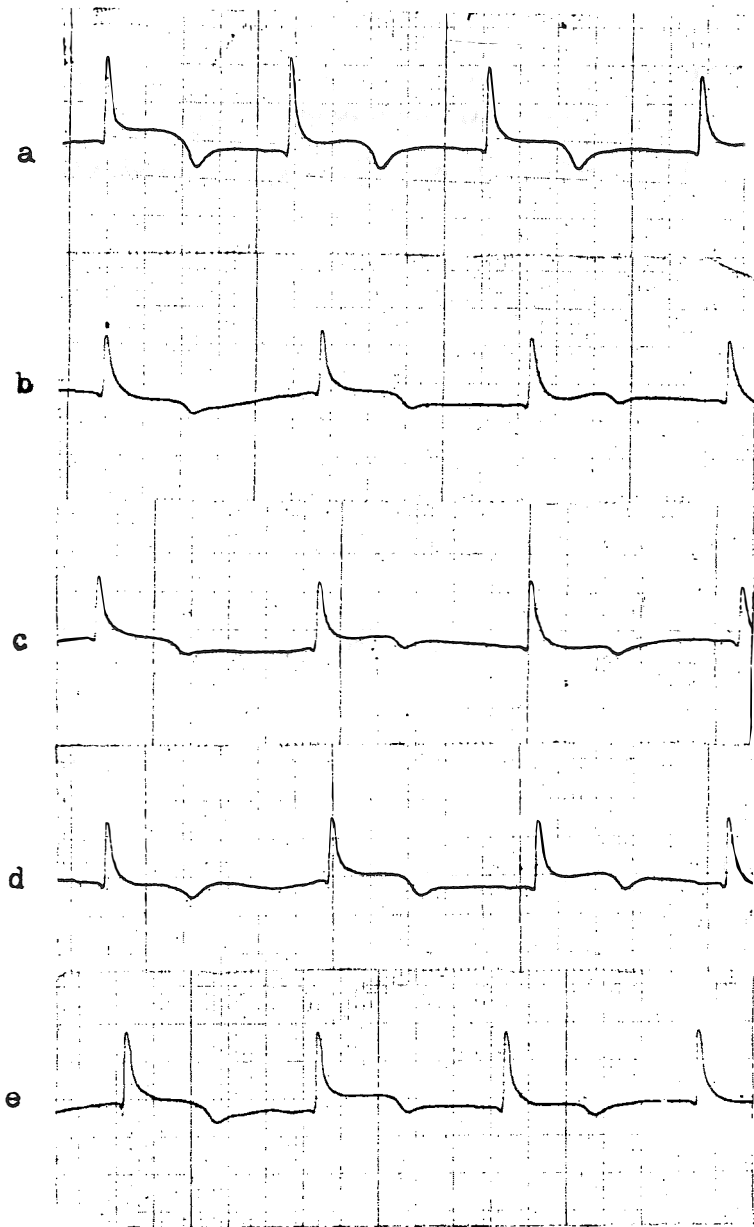


Fig. 1. Effects of 0.5 mg/l diazepam on the ECG of the eel, *Anguilla anguilla* L.

Table 1

Effects of 0.5 mg/1 diazepam on the cardiovascular-respiratory system of the eel,
Anguilla anguilla L.

| Time (min.) | Heart rate (beats/min.) | Respiratory rate/min. | Waves (mv.) | |
|-------------|-------------------------|-----------------------|-------------|-----------|
| | | | QRS | T |
| Control | 60.8 ± 3.7 | 46.1 ± 5.3 | 2.1 ± 0.7 | 0.6 ± 0.3 |
| 15 | 57.8 ± 7.2 | 43.8 ± 4.9 | 2.3 ± 0.7 | 0.5 ± 0.3 |
| 30 | 57.1 ± 7.0 | 43.3 ± 6.5 | 2.3 ± 0.8 | 0.5 ± 0.4 |
| 45 | 57.9 ± 8.0 | 45.0 ± 4.7 | 2.1 ± 1.0 | 0.4 ± 0.3 |
| 60 | 58.8 ± 7.9 | 45.8 ± 4.7 | 1.9 ± 1.1 | 0.4 ± 0.3 |

Average of 13 fish.

while the respiratory rate was calculated by counting the mandibular movements. The fish were individually subjected to 0.5 mg/1 diazepam (7-chloro-1.3 dihydro-1-methyl-5 phenyl-2H-1.4 benzodiazepine) in a glass aquarium (60 x 30 x 35 cm³) containing 20 liters of aerated dechlorinated tap-water. Changes in the waves amplitude, heart rate and respiratory rate under the influence of diazepam were recorded. Statistical test (t-test) was made to evaluate the significant changes caused by this drug.

RESULTS AND DISCUSSION

Changes in the cardiorespiratory systems of the eel after exposure to 0.5 mg/1 diazepam are shown in Table 1 and illustrated in Fig. 1 (a-e). Although some variations was observed among various specimens, the response pattern indicated in this figure may be regarded as reasonable typical. It is evident that fish exposed to diazepam resulted in a decrease of the heart rate from 60.8 to 57.1 beats/min. during the first 30 minutes and was followed by an increase in the rate to 58.8 beats/min. after 60 minutes. The decrease in the heart frequency after exposure to diazepam can be explained as being cause by a reduction in central catecholamine turnover (Chase et al. 1970; Fuxe et al. 1970; Corrodi et al. 1971) and increased in the level of acetylcholine (Consolo et al. 1972). On the other hand, fish exposed to diazepam exhibited a slight decreases in the respiratory rate from 46.1 to 43.3/min. during the first 30 minutes and was followed by an increase in the rate to 45.8/min. after 60 minutes which reflects a slight disturbances in fish respiratory system. A reduction in respiratory efficiency after exposure to diazepam was also reported by Goodman and Gilman (1970). As shown in Fig. 1, fish exposed to 0.5 mg/1 diazepam for 60 minutes resulted in decreasing of the QRS and T waves amplitude from 2.1 and 0.6 mv. to 1.9 and 0.4 mv. respectively which reflects a slight disturbances in the bioelectrical

activity of the cardiac muscle membrane. Statistically, changes in the heart rate, respiratory rate and waves amplitude after exposure to diazepam was found to be non-significant ($p > 0.05$), which means that this drug had a limited effects on the cardio and respiratory systems of the eel fish.

CONCLUSIONS

1. The major effects of diazepam appeared during the first 30 min.
2. The character of the obtained ECG's points out to a slight disturbances in the cardiac muscle cells.
3. Diazepam had non-significant effects on the cardiovascular-respiratory system.
4. With care, diazepam can be used in fisheries work.

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WPLYW DIAZEPAMU NA SERCOWE I ODDECHOWE REAKCJE WĘGORZA *ANGUILLA ANGUILLA* L.

STRESZCZENIE

Badano wpływ koncentracji w wodzie 0,5 mg/l diazepam na reakcje sercowe i oddechowe węgorza.

Stwierdzono, że największą aktywność wykazuje diazepam w pierwszych 30 min. ekspozycji, po których bioelektryczna aktywność mięśnia sercowego i rytm oddechowcy powracają do normy. Utrzymują się jedynie nieznaczne zakłócenia repolaryzacji komory mięśnia sercowego.

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