

## EVALUATION OF THE TRADITIONAL WAY OF EUTHANASIA OF FARMED FOXES FROM AN ANIMAL WELFARE POINT OF VIEW

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### Abstract

The aim of the study was to evaluate at what point consciousness is lost and brain activity ceases in electrically stunned blue foxes (*Alopex lagopus*), and to establish whether or not there is any return to consciousness after stunning before death. The study was conducted on 15 female blue foxes. All animals were sedated with an intramuscular injection of medetomidine. The results showed that the animals were unconscious immediately after stunning as documented by the absence of all reflexes. The EEG recording showed a status epilepticus pattern in all foxes immediately after stunning, and in none of the animals was a return to normal brain pattern observed. Such a generalised status epilepticus is connected with state of total unconsciousness and ultimately leads to brain death. All the foxes in our experiment had respiratory arrest and heart fibrillation after stunning. The heart changes were irreversible in all cases and most probably contributed heavily to the death of the brain after stunning, as the fibrillating heart is not able to provide the necessary blood flow to the brain and other organs. This leads to failure of multiple organ systems and inevitable death. Rapid disappearance of the BAER after stunning indicates brainstem affection and death. Magnetic resonance imaging examination and histopathological examination of the brain revealed no severe changes to the brains of any of the foxes, indicating that stunning mainly affects the function of the brain without distorting the anatomy of the brain. In conclusion, electrical stunning produces an immediate and irreversible state of unconsciousness and therefore is a humane way of euthanasia of farmed foxes.

**Key words:** stunning, *Alopex lagopus*, welfare, euthanasia, fur farm ethics

An ethical way of euthanasia in animals may be defined as the act of inducing a rapid and painless death. Various methods of euthanasia, including mechanical and electrical techniques, parenteral administration of anaesthetics and inhalation of gases, have been used over the years (Lambooy, 1982, 1983; Fatovich, 1992; Raj et al., 2006; Sandilands et al., 2006). At present, electrical stunning is widely favoured for various species of slaughter and farm animals. For electrical stunning to be effective in terms of animal welfare, it must fulfil two criteria: first, the animal must

become unconscious immediately; and second, it must remain unconscious until the loss of brain function due to death (Trapp and Taylor, 1986; Andrews et al., 1993).

It has been documented that after the head-only electrical stunning (both electrodes placed on the head), the flow of electricity through the brain increases its electrical activity, leading to an electroencephalogram pattern similar to that in generalised epileptic seizure (Croft, 1952; Hoenderken, 1978; Devine et al., 1986). This epileptic activity is regarded as analogous to loss of consciousness. The interval between the onset of stunning and the onset of the seizure-like state is about 0.2 seconds (Cook et al., 1992). These changes are transitory, and if the animal is allowed to recover from the seizure-like state, it would start to regain consciousness in about 40 seconds after the stun (Blackmore and Newhook, 1982). The duration of analgesia has been evaluated to last from 5 to 15 minutes after the stunning procedure (Cook et al., 1992). In contrast, in whole-body stunning (oronasal and rectal electrodes) the aim is primarily to bring about cardiac fibrillation or arrest in order to cause the death of the animal. The previously described processes in the brain are also observed in whole-body stunning (Anil and McKinstry, 1998; Cook et al., 1991; Lambooy, 1983).

Electroencephalography (EEG) has been used to record stunning procedures in chickens (Raj and O'Callaghan, 2004), pigs (Anil and McKinstry, 1998) and sheep (Velarde et al., 2000). The traditional way of stunning in farmed foxes is whole-body stunning (Loftsgaard et al., 1972; Hovland and Bakken, 2000). The animal is immobilised in the neck and tail region and an electrical current is applied with the aid of oral and rectal electrodes. Death of the animal is considered to be immediate and irreversible. However, to date, only one major clinical study (Lambooy, 1983) has been published on the stunning of farmed foxes. Immediately after stunning, all 12 of the tested foxes showed epileptiform insult and fibrillation of the heart; nevertheless, two of them recovered and had to be stunned a second time for killing. The conclusion drawn by Lambooy (1983) from the EEG and ECG measurements was that electrocution seems to be an effective method if the current delivery lasts for at least 3 to 4 seconds. In addition to this, better understanding of stunning procedures and their effectiveness is needed.

The aim of the present study was to establish at what point consciousness is lost and brain activity disappears in electrically stunned blue foxes (*Alopex lagopus*), and to establish whether or not there is a return to consciousness after stunning before death with the euthanasia method currently used in farmed foxes.

## Material and methods

The experiment was set up at the Fur Farming Research Station of Kannus (MTT Agrifood Research Finland). The study comprised healthy female blue foxes (*Alopex lagopus*) born between May 28 and June 12, 2004 and in good condition. They were fed and kept according to normal farming procedures.

Fifteen foxes were sedated with an i.m. injection of medetomidine (60 µg/kg; Orion, Turku, Finland), whereafter each animal was placed in a separate, quiet and

darkened room. Adequate sedation was reached when the animal was asleep and showed no sign of waking up when gently manipulated. If the animal reacted to touch and sound or was awake, an additional dose of medetomidine (20 µg/kg) was injected. A medetomidine injection of 20 µg/kg was repeated as needed to maintain an adequate level of sedation.

Once a sufficient level of sedation was attained, the animal was placed on a table in sternal recumbency and fitted with a muzzle. The muzzle was attached to the table so that it would immobilise the fox's head. An intravenous catheter was placed in the cephalic vein and blood samples were drawn. Normalcy was confirmed with the aid of a complete blood cell count and serum biochemistry profile (sodium, potassium, calcium, phosphorus, glucose, total protein, albumin, cholesterol, creatinine, urea, creatine kinase, alanine aminotransferase, alkaline phosphatase, aspartate aminotransferase, total bilirubin). The animal's heart rate, pulse and breathing were monitored, and palpebral (eyelid closure when the eyelids are touched), corneal (eyelid closure when the cornea is touched) and withdrawal reflexes (flexion of the leg when the pressure is applied to the toe) were examined every 5 minutes before the stunning. An otoscopy (examination of the external ear with otoscope) was performed and subcutaneous needle electrodes were inserted for recording of electrocardiography (ECG), electroencephalography (EEG) and brainstem auditory evoked responses (BAER). Initially, the duration of the ECG and EEG recordings was about 10 minutes. Recording of brainstem auditory evoked potentials started after EEG and ECG recording had continued for approximately 10 minutes. BAER recording lasted for about 10 minutes and was recorded simultaneously with the EEG and ECG.

The ECG and EEG recordings were performed simultaneously with the aid of the polygraphic lead in the EEG equipment. For this purpose two needle electrodes were placed over the left side of the thorax. The ECG recording was performed in the same way before and after stunning. Another polygraphic channel recording was used to document respiratory rate, which was also recorded at the same time as the EEG. Subcutaneous needle electrodes were inserted over the calvaria for the EEG recording. Before stunning, a 14 channel monopolar montage was used as described by Bergamasco et al. (2003). After stunning, however, a two channel monopolar EEG recording was made in order to document brain activity in the left and right hemispheres. The BAER was recorded after earplug-loudspeakers had been placed deep in the external ear canal. Alternating click stimuli of 90 decibels sound pressure level (dB SPL) were delivered. A masking noise of 50 dB SPL was applied to the contralateral ear. A total of 2000 clicks were averaged and each ear was recorded twice before the animal was stunned. In animals with an abnormal BAER before stunning, the BAER after stunning was not recorded. The BAER recording after stunning continued until responses ceased.

Monitoring by ECG, EEG and BAER was discontinued for the time of stunning and the electrodes were disconnected from the side of the equipment to prevent damage from the stunning current. "Fox Final" rectal and oral stunning electrodes were applied. The animal remained in the sternal recumbency position during stunning, immobilised only by the muzzle attached to the table. Whole-body stunning with the "Fox Final" equipment was applied. The duration and magnitude

of the electrical current passing through the fox's body was recorded. Each fox stunning and post-stunning episode was recorded on video tape (Panasonic G1 VHS-C Movie Camera NV-G1).

Reflexes and vital functions were recorded until they disappeared after stunning. The ECG, EEG and BAER recordings were taken until the death of the animal. Death was defined as the moment when the fox no longer had any motor activity and was not breathing, when the heart sounds could not be auscultated, the palpebral, corneal and flexor reflexes were absent and no normal heart or brain activity could be recorded by ECG, EEG and BAER.

Cerebrospinal fluid (CSF) punctures and examinations were performed immediately after the animal's death. In 10 foxes, the cisternal puncture was successful but in five no CSF could be obtained.

Magnetic resonance imaging (MRI) of the brains was performed with an 0.2T Esaote Vet-MRI system using standard human knee coils in 10 foxes. T1-weighted (T1W) images in transversal and sagittal planes and T2-weighted (T2W) images in transversal and dorsal planes were taken. The spin-echo sequences were as follows: 600.0–700.0 msec repetition time (TR) and 18.0/1 msec echo time (TE) for the T1W sequences. TR was 3000.0 msec and TE 90.0 msec for the T2W sequences. The studies were performed with a field of view (FoV) of 170 \* 170 mm in the T1W and 170 \* 170 or 200 \* 200 mm in the T2W images, a matrix size of 256 \* 192 in the T1W and 192 to 256 \* 192 in the T2W images, and 4.0 mm slice thickness (SL) in all images.

All 15 foxes were given a general pathological and histopathological central nervous system (CNS) examination. Central nervous system (CNS) in toto, along with representative samples from other internal organs, was fixed in 10% neutral buffered formalin and processed for routine histological examination with hematoxylin-eosin (HE) stain for all samples.

## Results

### Pre-stunning findings

The pre-stunning data are summarised in Tables 1–2. The experimental group comprised 15 healthy female foxes aged 20.9–21.4 months and weighing 7.48–10.36 kg (mean 7.99 kg). All animals were sedated with an initial intramuscular injection of medetomidine (60 µg/kg). Six foxes required an additional injection of 20 µg/kg of medetomidine to achieve a sufficient level of sedation. The second injection was administered 19–37 minutes after the first one. A third 20 µg/kg injection of medetomidine was needed in one fox.

The level of sedation was monitored by testing the palpebral, corneal and withdrawal reflexes. The palpebral and corneal reflexes were preserved and the flexor reflex was absent during the sedation time in all foxes except two, in which the palpebral reflex was absent. The heart rate of the foxes in sedation ranged from 40 to 88 beats per minute, the pulse was well palpable and the breathing frequency ranged from 13 to 48 breaths per minute in all foxes.

Table 1. Prestunning physiological data of experimental foxes in medetomidine sedation

Fox	Age (months)	Body weight (kg)	Heart rate (beats/min)	Respiratory rate (breaths/min)	Palpebral reflexes	Corneal reflexes	Flexor reflexes	Otoscopy results
1	21.2	8.820	48–52	13–18	present	present	absent	LRdirty
2	21.2	9.680	68–72	16–20	present	present	absent	LRdirty
3	21.4	9.660	64–80	30–48	present	present	absent	LRclean
4	21.2	10.360	48–68	18–24	present	present	absent	LRclean
5	21.1	8.640	68–76	16–17	present	present	absent	Rclean, L dirty
6	20.9	9.120	56–72	23–27	present	present	absent	LRclean
7	21.2	9.640	60–84	13–20	absent	present	absent	LRclean
8	21.4	7.860	60–88	20–28	present	present	absent	LRclean
9	21.2	8.020	52–64	13–20	present	present	absent	LRdirty
10	21.3	7.620	40–64	16–18	present	present	absent	LRclean
11	21.3	7.480	64–72	16–24	present	present	absent	LRclean
12	21.1	7.500	44–60	13–20	absent	present	absent	LRdirty
13	21.4	8.840	60–80	15–18	present	present	absent	Rdirty, L clean
14	21.1	7.720	68–76	16	present	present	absent	LRclean
15	20.9	7.740	56–60	6–20	present	present	absent	LRdirty

L = left, R = right.

Table 2. Stunning time, stunning current and electrodiagnosical findings in experimental foxes

Fox	Stunning time (sec)	Stunning current (A)	Post stunning corneal reflexes	ECG/EEG recording after stunning (minutes)	EEG (no. of channels)	Duration of SE (seconds)	Disappearance of BAER after stunning (seconds)
1	5.21	0.44	absent	5.30	2	120	not evaluated
2	4.35	0.43	absent	7.30	2	120	not evaluated
3	2.48	0.45	absent	4.08	2	120	200
4	2.34	0.50	absent	5.00	2	100	200
5	2.75	0.69	present*	6.20	2	95	200
6	3.21	0.51	absent	3.40	2	120	immediately
7	3.98	0.68	absent	3.50	2	90	250
8	4.29	0.32	absent	3.43	2	100	30
9	4.14	0.32	absent	5.00	2	102	not evaluated
10	4.11	0.33	absent	6.14	2	106	78
11	3.33	0.34	present*	17.00	14	102	not evaluated
12	3.59	0.34	absent	18.20	14	60	not evaluated
13	3.39	0.33	absent	4.10	14	110	not evaluated
14	3.72	0.32	absent	20.00	2	90	250
15	3.56	0.32	present*	2.35	2	110t	not evaluated

present\* – the corneal reflex was present immediately after stunning but disappeared during 10 seconds after stunning.  
SE = status epilepticus.

Complete blood cell count and serum biochemistry profile examination showed no clinically significant changes in any of the 15 experimental animals. Otoscopic examination revealed normal external ear canals and good visibility of the tympanic membranes in eight foxes (3, 4, 6, 7, 8, 10, 11, 14). In five of animals (1, 2, 9, 12, 15), though, the external ear canals were totally obliterated by dirt and debris. In two foxes, one side was normal and one was obliterated by dirt (5: left dirty; 13: right dirty). No attempt was made to clean the ears.

Electrocardiography showed normal shaped QRS complexes in all animals, and the recorded heart rate correlated well with the pulse palpation on the femoral artery and heart auscultation, ranging from 40 to 88 beats per minute. Under medetomidine sedation, EEG examination revealed a normal pattern of EEG comparable to that recorded in cats and dogs.

BAER examination before stunning showed normal hearing (responses) in eight foxes (3, 4, 5, 6, 7, 8, 10, 14), decreased hearing on the left side in three foxes (1,12,15), decreased hearing on the right side in two foxes (11, 13) and decreased hearing on both sides in two foxes (2,9). The decreased hearing was defined by reduced amplitude and abnormal appearance of the waves I–V on visual examination of the curves.

### **Post-stunning findings**

Stunning and electrodiagnosical findings are summarised in Table 2 and Figures 1–5.

During the stunning episode, the animals showed tonic muscle contraction involving the muscles of the trunk and extremities. This generalised muscle cramp ceased after the stunning device was turned off. The stunning time ranged from 2.34 to 5.21 seconds, and the stunning current was between 0.32 and 0.69 A. All animals appeared to be unconscious immediately after stunning as they were unresponsive, and the palpebral and corneal reflexes were absent in all except three foxes in which the corneal reflex was present for about 10 seconds after stunning. The majority of the foxes had low amplitude muscle tremor in the muscles of the face and the limbs during 1–3 minutes after stunning.

No pulse could be palpated or heart auscultated immediately after stunning. The breathing was stopped after the stunning in all foxes. In none of foxes was normal ECG pattern recorded after stunning. A clear cardiac fibrillation pattern (high frequency and amplitude and unrecognisable QRS complexes) was noticed from the beginning of recording after stunning. In three foxes, the ECG was recorded until the end of fibrillation. The fibrillation pattern gradually declined in amplitude over 17–20 minutes, ending in an isoelectric (flat) line. In the remaining 12 animals, the ECG recording was discontinued when the amplitude of the fibrillation was severely reduced. The ECG pattern did not return to normal in any of the animals.

None of foxes had a normal EEG pattern after stunning. Immediately after stunning, a high frequency and high amplitude status epilepticus pattern was recorded in all foxes. However, the amplitude decreased markedly during 30 seconds after stunning. EEG was not able to recognise any brain activity after 60–120 seconds in any of the foxes as the brain waves were flat (isoelectric line).



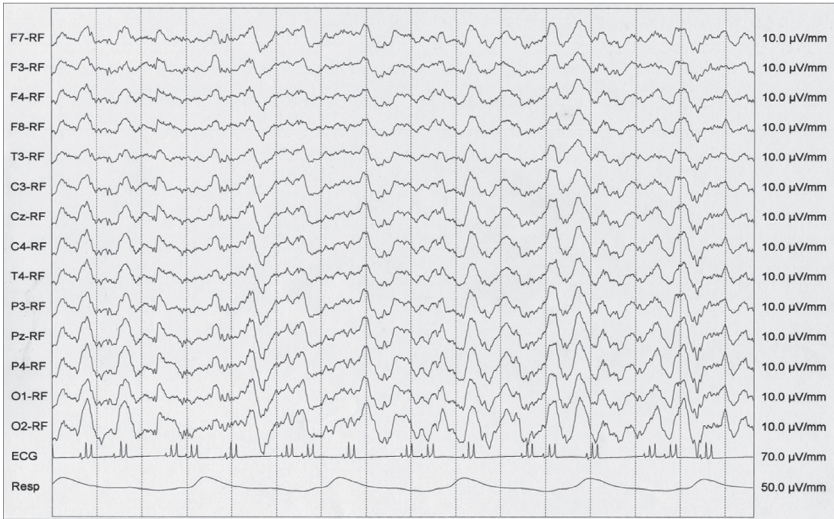


Figure 1. The 14 channel electroencephalographic recording of fox no. 2 before stunning. F (frontal), C (central), P (parietal), T (temporal), O (occipital), RF (reference), ECG (electrocardiography), Resp (respiratory) electrodes. Fz, Cz, Pz represent medial sagittal line electrodes. Numbers indicate the hemispheric site: even numbers – right, odd numbers – left hemisphere. Sensitivity 7  $\mu$ V/mm, time constant 0.3 seconds, Hf 30 Hz, notch and muscular filters inserted. Reference electrode was placed on the bridge of the nose and ground electrode was inserted caudally to occipital protuberance. Intramuscular lidocaine injections were not used. The EEG pattern is similar to recordings in medetomidine sedated dogs and cats. Regular heart rhythm can be detected on the ECG line with identifiable P, QRS and T waves. The regular respiratory rate is recorded on the respiratory line.

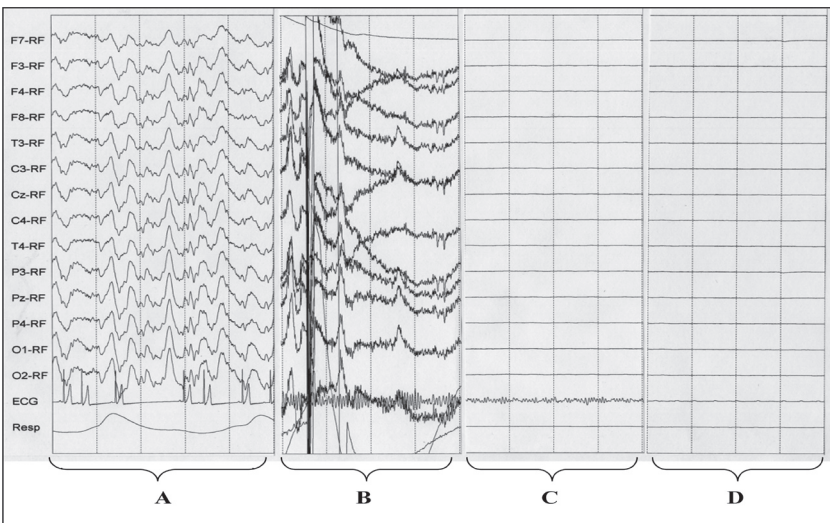


Figure 2. The 14 channel electroencephalographic recording of fox no. 11. A (before stunning), B (immediately after stunning), C (8 minutes after stunning) and D (16 minutes after stunning). The normal EEG, ECG and respiratory pattern in A is similar as shown in Figure 1. The EEG recording immediately after stunning (B) shows distortion of the lines and presence of status epilepticus pattern (high frequency, various amplitudes) in all leads. The ECG line in B shows heart fibrillation. The recording in C shows brain death pattern represented by the isoelectric (flat) line in EEG recording, heart fibrillation pattern (although reduced in amplitude) and respiratory arrest. The recording 16 minutes after stunning (D) shows no detectable electrical activity of the brain and heart and respiratory arrest.



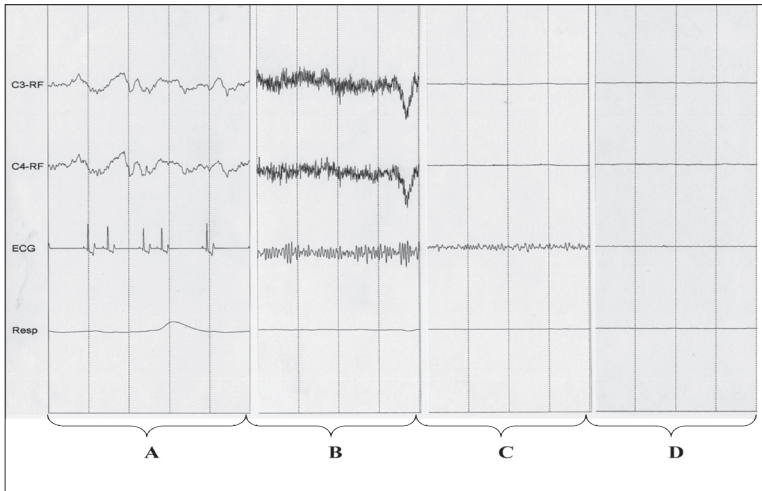


Figure 3. The 2 channel electroencephalographic recording of fox no. 14. A (before stunning), B (immediately after stunning), C (2 minutes after stunning) and D (17 minutes after stunning). The normal EEG, ECG and respiratory pattern in A is similar as shown in Figures 1 and 2. The EEG recording immediately after stunning (B) shows distortion of the lines and presence of status epilepticus pattern (high frequency, various amplitudes) in both leads. The ECG line in B shows heart fibrillation and respiratory line arrest of respiration. The recording in C shows brain death pattern represented by the isoelectric (flat) line in EEG recording, heart fibrillation pattern and continuous respiratory arrest. The recording 17 minutes after stunning (D) shows no detectable electrical activity of the brain and heart and respiratory arrest.

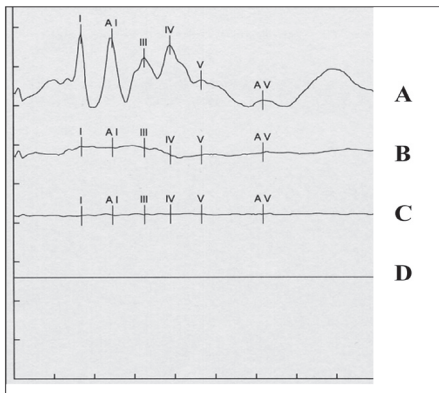


Figure 4. The brainstem auditory evoked potentials of the fox no. 8 after stunning. The recording A was obtained during the first 30 seconds after stunning. It represents normal BAER finding with identifiable I, II, III and IV waves. The recording B is obtained during the 30 seconds immediately after the A recording (334 clicks; frequency 10 Hz). The B recording shows severely reduced responses in amplitude and unidentifiable waves. The C recording shows absence of responses caused by brain death. C recording was obtained immediately after B recording (approximately one minute after stunning) and lasted 113 seconds (1139 clicks; frequency 10 Hz). D recording was not performed.

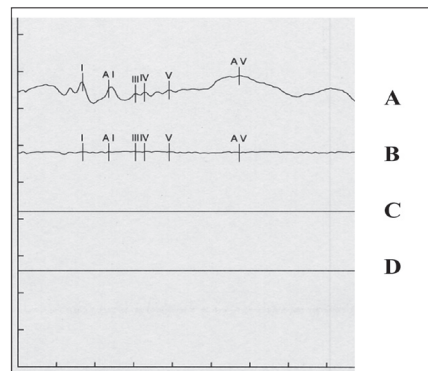
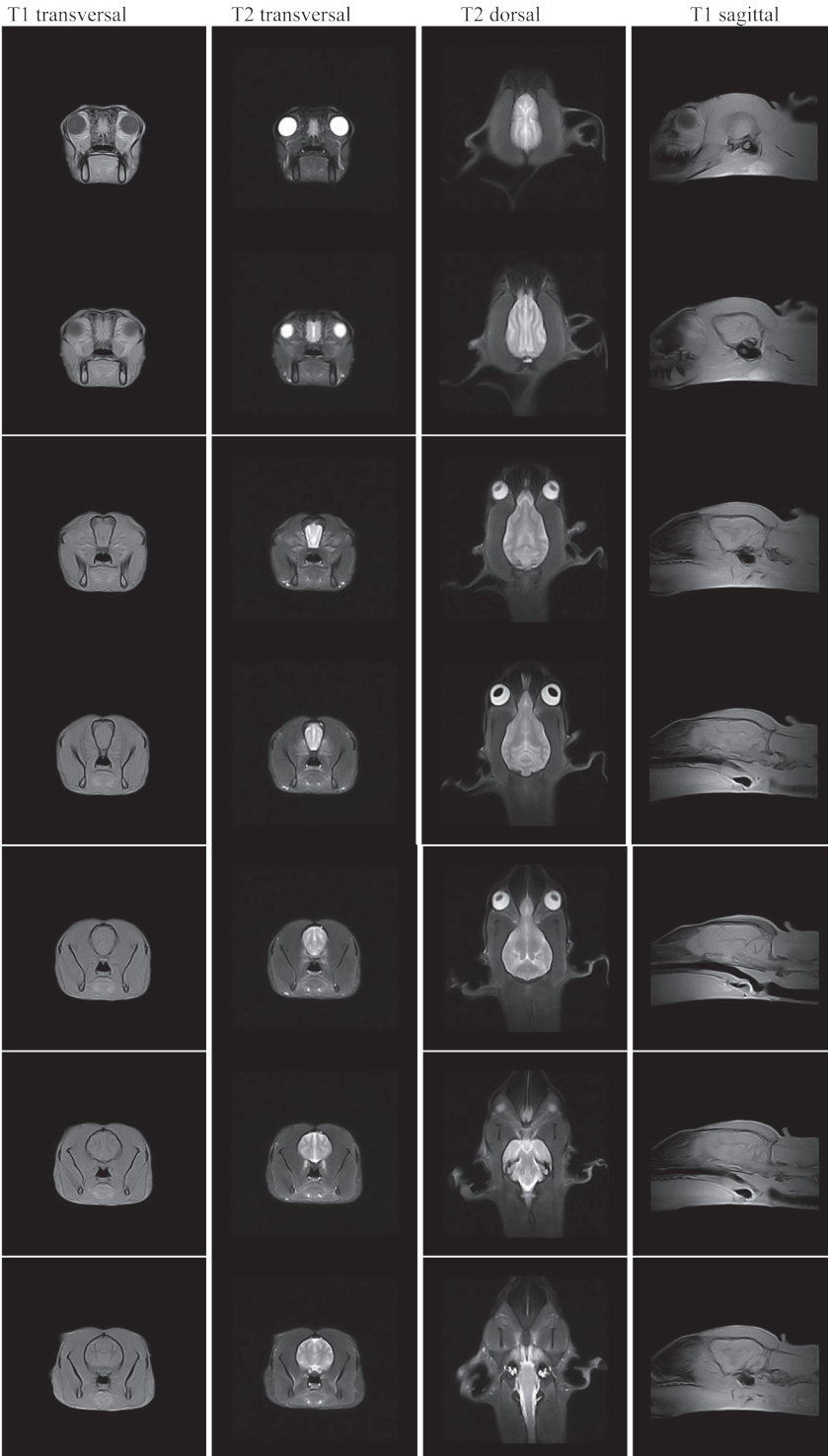
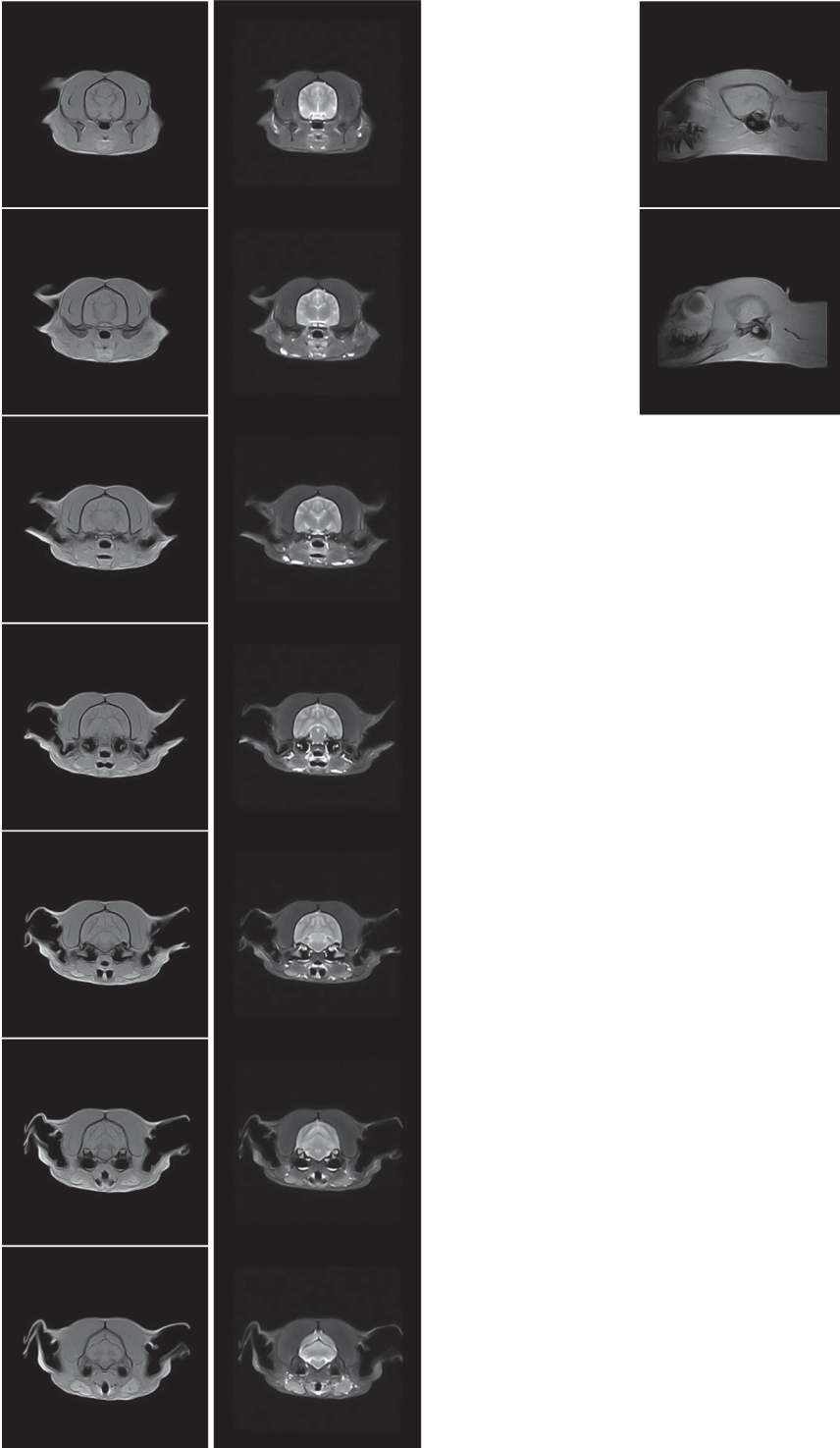


Figure 5. The brainstem auditory evoked potentials of the fox no. 4 after stunning. The recording A was obtained during the first 200 seconds after stunning. It represents abnormal BAER with hardly identifiable I, II, III and IV waves. The recording B is obtained during the 130 seconds immediately after the A recording (1304 clicks; frequency 10 Hz). The B recording shows absence of responses caused by brain death. C and D recording were not performed.





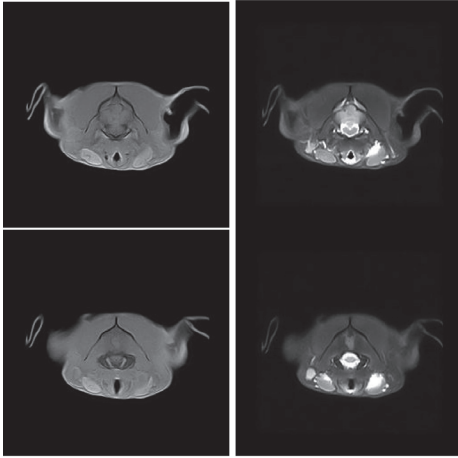


Figure 6. The magnetic resonance appearance of the fox after electrical stunning. Images in all three plains were obtained (T1 and T2 transversals, T2 dorsals and T1 sagittals). No significant pathological changes could be seen on the MRI examination.

The post-stunning BAER examination results were evaluated in eight foxes (3–8,10,14) in which responses had been normal before stunning. The BAER had a tendency to be present immediately after stunning, but later it decreased in amplitude, became distorted and gradually disappeared in all foxes. The BAER was not detectable in fox no. 6 immediately after stunning. In the rest of the foxes the BAER disappeared between 0.5 and 4.3 minutes after stunning.

The results of the CFS examination were considered normal in all 10 foxes in which the CSF puncture was successful. In six of them, the Pandy reagent reaction was negative and a cell count did not reveal any nucleated or red blood cells (0 cells per microlitre). In the remaining four foxes, the Pandy reagent reaction was negative but there was mild contamination of samples by the red blood cells (10–800). This contamination was judged to be from the puncture itself.

Post-mortem MRI examination revealed no significant pathological changes in the brains of any of the 10 foxes (6–15) examined.

Pathological examination revealed generally mild changes. The most frequent finding was bleeding in the pancreas (12/15). However, the significance of this finding is unclear. No significant changes were revealed in the examination of the cardiovascular system. Mild bleeding was observed in the area of the cisterna magna (brainstem/cerebellum) and was attributed to the CSF puncture (foxes 3, 5, 9, 13). No other significant changes were noted in the CNS examination.

## Discussion

The foxes included in this study constituted a homogeneous group of healthy young animals. Their normalcy was based on historical data (breeder's information), good health status and normal blood examinations.

All animals attained a good level of sedation with the current anaesthesia protocol. The sedation was deep enough to permit safe manipulation of the animal, to minimise stress and to maintain homogeneous vital functions in the whole study population. No adverse side effects were observed in any of the animals. The sedation level also enabled the recording and stunning electrodes to be placed safely, and vital functions to be monitored before and after stunning.

Pre-stunning ECG, EEG and BAER were recorded to document the normal values in sedated animals. Pre-stunning measurements show that the electrodiagnosical examination findings in foxes are comparable to those in dogs and cats (Itamoto et al., 2001; Farber et al., 1997). Electrodiagnosical examinations such as EEG and BAER are usually performed in cats and dogs under sedation as animals are not cooperative when awake. The alternative to sedation would be physical restriction but that would cause the animal considerable stress and discomfort. We used sedation in our experiment partly to reduce such stress and partly to ensure that we obtained readable recordings.

All the foxes in our study reacted similarly to stunning. Whole-body cramp was observed throughout the current delivery time (2.34–5.21 seconds). Immediately after stunning current was switched off, the animals' muscles relaxed. The animals remained unconscious although mild muscle contractions of the facial musculature and extremities were observed. These mild muscular contractions correlate well with the occurrence and duration of the status epilepticus activity of the brain noted on EEG. It most probably reflects the epileptic activity in the motor cortex of the foxes. In addition to paralysis of motor function (inability to move) changes in sensory function were observed. Immediately after being stunned, the animal was unconscious as documented by the absence of all reflexes, and was in a status epilepticus as shown by the EEG recording. There was no return to normal brain pattern in any of the animals. Such a generalised status epilepticus is associated with the state of total unconsciousness. We can therefore logically conclude that stunning leads to unconsciousness and eventual brain death.

The brain death is most likely caused by electrical insult to the brain itself and by the changes in the heart. All the foxes in our experiment had respiratory arrest and heart fibrillation after stunning. The heart changes were irreversible in all cases and most probably made a major contribution to the death of the brain after stunning, as the fibrillating heart is not able to provide necessary blood flow to the brain and other organs. This leads to multiple organ failure and inevitable death.

The BAER has not previously been reported in stunned animals. Our findings indicate that, initially, the brain is able to respond to sound stimuli after stunning, but that this response diminishes in time as the changes in the function of the neurons advance. If the EEG is mainly documenting the cortical changes, the BAER is recorded from the chain of neurons involved in the hearing function. These neurons are mainly located in the brainstem. Rapid disappearance of the BAER after stunning indicates brainstem affection and death. We can postulate that, after stunning, dysfunction of the cerebral cortex due to the status epilepticus occurs first and later whole brain death due to failure of the heart to deliver nutrients to the brain. The brain death is a gradual process and was completed in all of our animals within 5 minutes of stunning.

MRI and histopathological examination of the brain did not reveal severe changes in the brains of any of the foxes, indicating that stunning mainly affects the function of the brain and the anatomy of the brain is not distorted. It would further seem that the blood supply to the brain is interrupted without causing bleedings or other vascular changes in the central nervous system.

In conclusion, the experiment on the electrical stunning of foxes reported here shows that, under the described conditions, the stunning method is safe and quick, causing irreversible changes to the central nervous and cardiovascular systems. Electrical stunning brings about an immediate and irreversible state of unconsciousness in the animal and therefore is an efficient and humane way of euthanasia for farmed foxes.

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### Ocena tradycyjnej metody eutanazji lisów fermowych z punktu widzenia dobrostanu zwierząt

#### STRESZCZENIE

Celem pracy była ocena momentu utraty świadomości i ustania aktywności mózgu u ogłuszanych prądem lisów niebieskich (*Alopex lagopus*) oraz stwierdzenie, czy świadomość po ogłuszeniu powraca przed śmiercią. Doświadczenie przeprowadzono na 15 samicach lisa niebieskiego. Wszystkie zwierzęta poddano sedacji poprzez domięśniowe podanie medetomidyny. Uzyskane wyniki pokazują, że zwierzęta traciły przytomność bezpośrednio po ogłuszeniu, na co wskazuje brak wszelkich odruchów. Zapis EEG wykazał stan padaczkowy bezpośrednio po ogłuszeniu u wszystkich lisów, natomiast u żadnego z nich nie stwierdzono powrotu mózgu do stanu normalnego. Taki uogólniony stan padaczkowy związany jest ze stanem całkowitej utraty przytomności i prowadzi ostatecznie do śmierci mózgu. Po ogłuszeniu, u wszystkich zwierząt uczestniczących w doświadczeniu stwierdzono zatrzymanie oddechu i migotanie serca. Zmiany w sercu były we wszystkich przypadkach nieodwracalne i najprawdopodobniej w znacznym stopniu przyczyniły się do śmierci mózgu po ogłuszeniu, ponieważ migotające serce nie jest w stanie zapewnić dopływu potrzebnej krwi do mózgu i innych narządów. Prowadzi to do niewydolności wielonarządowej i nieuchronnej śmierci. Szybki zanik odpowiedzi pnia mózgu na bodziec akustyczny (BAER) po ogłuszeniu wskazuje na ustanie funkcji pnia mózgu i śmierć. Badanie rezonansem magnetycznym oraz histopatologiczne badanie mózgu nie ujawniły poważnych zmian w mózgu któregośkolwiek z lisów, co wskazuje, że ogłuszanie wpływa głównie na funkcję mózgu, nie uszkadzając jego budowy. W podsumowaniu stwierdza się, że ogłuszanie prądem wywołuje natychmiastowy i nieodwracalny stan utraty świadomości, a zatem jest humanitarną metodą eutanazji lisów fermowych.