

CARBON DIOXIDE ANAESTHETIZATION OF PIGS.

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SUMMARY

Based on electroencephalographic recordings obtained during carbon dioxide anaesthetization (stunning) of pigs it has been found that the loss of consciousness is rapid (less than 30 seconds) and probably not stressful.

The physiological effects of carbon dioxide on heart and blood vessels leads to an initial rise in blood pressure. High concentrations of carbon dioxide or prolonged exposure can lead to disturbed heart function / cardiac arrest which often is reversible.

Inhalation of 70 - 85% carbon dioxide in atmospheric air for up to 90 seconds does not lead to a serious decrease in the partial pressure of oxygen in arterial blood (not below 55 mm Hg) and it can thus be stated, that the effect of carbon dioxide anaesthetization is not caused by hypoxia.

The main conclusion of the experiments is that carbon dioxide anaesthetization of pigs is a suitable method for pre - slaughter stunning.

INTRODUCTION

Carbon dioxide anaesthetization as pre - slaughter stunning has been used in pig producing countries for many years (Slater 1952). From time to time, however, the ethical aspects have been discussed (Cantiene 1977 and Hoenderken *et al.* 1979). The need for further knowledge on the physiological effects and the suitability of the procedure to produce a reliable and fast loss of consciousness has led to a series of experiments to clarify the situation.

The central problem was to establish whether it is possible to determine the time when the pig becomes unconscious in relation to the motoric unrest, which often is exhibited by pigs during carbon dioxide anaesthetization.

In addition a number of measurements of blood circulation and respiratory function has been performed in order to give improved knowledge of physiological changes taking place during carbon dioxide anaesthetization.

EXPERIMENTAL METHODS

An experimental chamber with dimensions similar to commercial carbon dioxide stunning installations has been used in order to obtain electroencephalographic (EEG) recordings of pigs during carbon dioxide anaesthetization.

Measurements in commercial installations were not attempted because of the unfavorable conditions for obtaining good recordings (movements, electrical noise from motors).

Different combinations of concentration of carbon dioxide and time were tested in order to simulate the situation in a commercial carbon dioxide stunning equipment.

The chamber was equipped with a window in order to allow clinical observations and video recordings of the swine.

Implanted electrodes in contact with the brain membrane (dura mater) were used to obtain signals, which were amplified and recorded on a tape recorder and later analyzed in a frequency analyzer.

Blood pressure was measured and blood samples for gas analyses were taken through a catheter positioned in an artery of the neck or ear. For these measurement the anaesthetic gas was applied via a face mask.

Electrocardiograms were recorded between electrodes positioned on either side of the chest or between the chest and the base of the ear.

RESULTS

It was found that the EEG recordings indicated that the pigs were conscious for the first 20 seconds of carbon dioxide anaesthetization. The dominant frequency is approx. 10 per seconds with a low amplitude. After further 10 seconds a reduced level of consciousness is apparent (a frequency of approx. 4 per second is dominating and the amplitude is higher) followed by deep narcosis.

The frequency and amplitude changes are similar to those seen during halothane anaesthetization.

Carbon dioxide anaesthetization was found to be accompanied by an increase in blood pressure from 120 mm Hg to approx. 200 mm Hg. In some pigs subjected to stunning with high concentrations of carbon dioxide a sudden drop in blood pressure indicating reduced heart function was observed. This was confirmed by electrocardiographic recordings.

Measurement of arterial blood showed that although very high concentrations of carbon dioxide is rapidly obtained there is not a serious reduction in the partial pressure of oxygen.

Inhalation of a mixture of 70% carbon dioxide in atmospheric air for 90 seconds did not cause the partial pressure of oxygen in arterial blood to sink below 55 mm Hg (normal values around 70 mm Hg). A very rapid increase of the partial pressure of carbon dioxide was observed. Within 10 seconds an increase from 40 mm Hg to 200 mm Hg was observed.

In connection with this rise in partial pressure of carbon dioxide there is a pronounced decrease in blood pH from normal values around pH 7.4 to values around pH 6.9. (70% carbon dioxide in atmospheric air).

Clinical observations showed, that pigs on contact with a mixture of carbon dioxide and atmospheric air did not show any immediate reaction. Specifically, no observations indicating local irritation of mucous membranes were made (blinking, sneezing).

The behaviour which can be observed when the pig is lowered into the test chamber can be described in three phases:

1. **Lag Phase:** This period is shorter with higher carbon dioxide concentrations. It is 35-55 seconds at 40% carbon dioxide and approx. 20

seconds at 65 %. The animal is quiet.

2. Motoric unrest phase: This phase starts suddenly. The pig makes running movements for around 10 seconds.

3. Relaxation phase: This phase is reached quicker at higher carbon dioxide concentrations. At 65% carbon dioxide the relaxation starts approx. one minute after the animal has been lowered into the chamber.

By repeated carbon dioxide anaesthetization of the same pigs (after a rest period) the same sequence and duration of phases is observed. Thus, there is no shortening or absence of the quiet initial phase, which might be expected if there was a recollection of an unpleasant experience.

DISCUSSION

The inhalation of a mixture of carbon dioxide and atmospheric air is a practical method of stunning pigs for slaughter.

The findings of Cantieni (1977), that the method did not correspond to the requirements of a good anaesthesia

could not be confirmed, nor could the suggestion of Hoenderken et al. (1979), that there might be reason to believe that the loss of consciousness could be caused by lack of oxygen instead of an anaesthetic effect of carbon dioxide.

The observed changes in the frequencies of the electroencephalographic recordings suggests that the pigs are unconscious in the phase of motoric unrest. This is in accordance with the findings of Forslid 1987.

CONCLUSION

The conclusion of the experiments are that the loss of consciousness during carbon dioxide anaesthetization is rapid and is similar to other form of narcosis. Carbon dioxide anaesthetization thus appears to be an acceptable method for pre - slaughter stunning.

REFERENCES

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