Summary

Medicine, pharmacology and biology cannot, for various reasons, totally refrain from animal experiments. This includes the necessity of painless anaesthesia and euthanasia of experimental animals. CO₂ anaesthesia of rodents is a commonly used method, nevertheless, little is known about whether this method is painful to the animal. The present work should contribute to answering the question of whether CO₂ anaesthesia of laboratory rats is compatible with the humane treatment of laboratory animals.

A method has been developed that can evaluate CO₂ anaesthesia for symptoms of distress. As a first step to this goal, suitable criteria for the assessment of distress were defined on the basis of the existing literature. The following experimental studies focused on two major aspects. First, the behaviour of the animals during CO₂ anaesthesia was monitored and checked for attempts to escape, retreat or attack as overt signs of distress. Secondly, blood ACTH, corticosterone and glucose levels were measured during anaesthesia as objective criteria of distress.

In the first experiment 59 rats were anaesthesised with 2 L/min, 4 L/min and 6 L/min CO₂, respectively. Three consecutive stages during anaesthesia were observed. An initial increased respiration rate was followed by immobility that eventually led to total muscle relaxation. The onset of these symptoms showed the smallest variability at 6 L/min CO₂, so this flow rate was chosen for subsequent experiments. In order to measure objective distress parameters blood was taken during the course of CO₂ anaesthesia. According to the observed stages samples were collected at 30 sec, 75 sec and 120 sec, respectively. The CO₂ concentrations at these timepoints were about 18%, 39% and 55%, respectively.

48 animals were subdivided into four groups. Prior to CO₂ anaesthesia rats either received an acepromazin sedative or were put under a general anaesthetic (pentobarbiturate). Control groups were given placebos in the same way as the drugs used.

The pretreated animals were compared to the controls during subsequent CO₂ anaesthesia. If CO₂ would cause distress reactions, one would expect the unconscious animals to show less severe alterations of the measured stress
parameters. Contrary to this, neither a difference in behaviour nor statistically significant alterations of the blood stress parameters could be found. Hence, the performed experiments could not detect any symptoms of suffering during the CO$_2$ anaesthesia.

Summarising, anaesthesia and euthanasia of laboratory rats using CO$_2$ can be evaluated, on the basis of the obtained data, to be compatible with the humane treatment of animals. The method developed can be easily adapted to studies with other gas-based anaesthetics.