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EFFECT OF MALIGNANT HYPERTHERMIA USING SEVOFLURANE GAS ON VITAL SIGNS OF *CAVIA PORCELLUS* (GUINEA PIG)

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ABSTRACT
This study assessed the effects of sevoflurane gas on the vital signs of Cavia porcellus with experimentally induced malignant hyperthermia. For the determination of malignant hyperthermia, 50 Cavia porcellus were placed in an anesthesia chamber for 5 minutes and subjected to a mixture of air with 3% sevoflurane gas. Only 6% of them reacted positively, while most of them, 94%, were negative. The average body temperature of the positive kits was 38.9ºC, oscillating between 38.7 and 39.1 ° C, while the negative ones averaged 37.9 ° C. The positive kits had an average of 142.3 breaths per minute compared to the negative ones, which was determined to be 83.7. The number of heart beats per minute in the kits with a positive reaction to sevoflurane averaged 205 and the negative ones 119.5. It was concluded that for every 16 guinea pigs, one will react to the sevoflurane gas exposure positively based on the result obtained from the vital sign. Only the positive ones presented muscle tremors.

Key words: Guinea pig (*Cavia porcellus)*. vital signs, heartbeat, Malignant hyperthermia, and sevoflurane gas.

INTRODUCTION

Guinea pigs are sensitive to stress since they have nervous system. Malignant Hyperthermia is also caused by factors such as changes in temperature and prostration (the state of being extremely weak or subservient.) due to heat (Gilmar *et al.,* 2021). Knowing the physiological constants of the guinea pig allows us to know when there are alterations that indicate general metabolism problems (Calderón and Cazares, 2008).

The guinea pig is a domestic species whose meat is used in most Andean countries in Latin America. They are prone to malignant hyperthermia (MH), which is a pharmacogenetic disorder of skeletal muscle (Gilmar *et al.,* 2021). It has a hypermetabolic response to potent volatile anesthetic gases such as halothane, sevoflurane, desflurane, and depolarizing muscle relaxant succinylcholine, and rarely, in humans, to stresses such as vigorous exercise and heat (Gilmar *et al.,* 2021). Animals sensitive to general anesthetics as well as humans include pigs, horses, cows, deer, chickens, rabbits, European wild boars, cats, and dogs (Blood, 1988). This present study is to determine the vital sign exhibited by guinea pigs experimentally induced Malignant Hyperthermia.

MATERIALS AND METHODS

Experimental site

The research was carried out on a commercial farm, located in the La Libertad region – Peru.

Experimental animal

Fifty healthy, 15-day-old weaned kits, *Cavia porcellus* of the Peru breed, with a weight of 250 ± 10g, were randomly selected from all the kits weaned weekly. All the animals were housed in a deep litter floor of 1 m long x 1m wide with 10 animals per pool. They had the same feed, handling, management, and sanitation system. The animals were fed husk and concentrate and had water in the suckers *ad libitum*.

Exposure of animals to sevoflurane gas

All the kits vital signs were checked before and after being exposed to sevoflurane gas within an anesthesia chamber of dimensions (40 cm x 35 cm x 30 cm). Three animals were exposed at a time to the mixture of air and sevoflurane at a concentration of 3% for a period of 5 minutes. The behavior of the kits were observed in this chamber and after exposure, their vital signs were determined.

Determination of malignant hyperthermia of Cavia porcellus

The presence of malignant hyperthermia was established through their body temperature, respiratory rate, heart rate, and muscle tremors, after exposure of the animals to sevoflurane gas. Hyperthermic animals were considered those that had high body temperature, high respiratory and heart rates, and muscle tremors. Non-hyperthermic animals were classified as those animals whose body temperature were normal and their vital signs were not affected by exposure to sevoflurane gas.

Statistical analysis

The data analysis was carried out through a statistical design of normal distribution Z, using the mean, minimum, and maximum values, and the standard deviation as measures of central tendency to interpret the results obtained. Bar graphs and percentage measurements were made for a better expression and support of the final results. Excel and SPSS version 25 software were used.

RESULTS

Number of cases of positive and negative kits exposed to sevoflurane gas

Of the 50 *Cavia porcellus* monitored, only 3 kits (6%) of them reacted positively to sevoflurane gas exposure, while most of them, 47 kits (94%), were negative (Table 1 and Figure 1). The prism graph pad shows significant difference between the kits that react positive and negative to sevoflurane gas.

Table 1: Number and proportion of positive and negative reaction to sevoflurane gas

Positive reaction		Negative reaction	
N	**%**	**N**	**%**
3	6	47	94

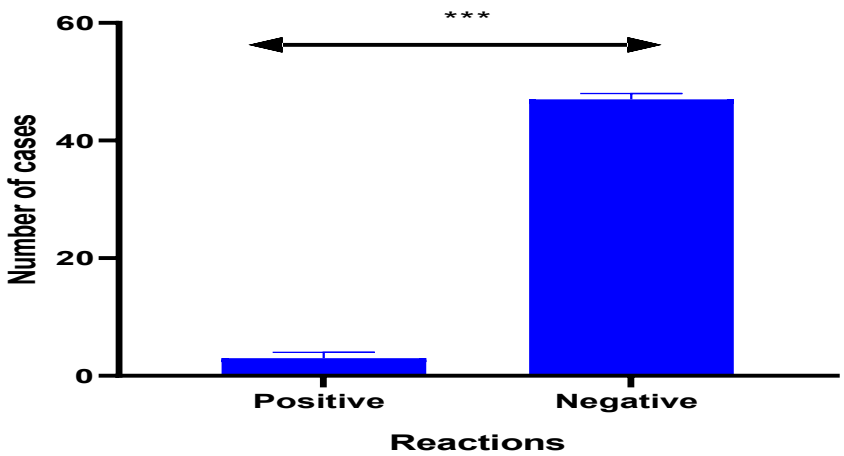


Figure 1. Positive and negative reaction of *Cavia porcellus* to sevoflurane gas.

Vital Signs of Positive Kits

Table 2 shows the descriptive statistics of the body temperature, breathing frequency and heart beat rate of the positive kits. The average body temperature of the positive kits was 38.9ºC, ranging between 38.7 and 39.1 ° C. The positive kits had an average of 142.3 breaths per minute. The kits with a positive reaction to sevoflurane had an average of 205 heart beats per minute.

Table 2: Descriptive statistics of the body temperature of the positive kits

Vital sign	Number of Kits	Minimum	Maximum	Mean	Standard deviation
Temperature °C	3	38.7	39.1	38.9	±0.21
Breathing frequency (Rep / min)	3	132	149	142.3	±9.10
Heart rate (Beat / min)	3	190	215	205	±13.20

Breathing frequency

DISCUSSION

Number and proportion of positive and negative kits to sevoflurane gas

In this study, it was observed that, out of the 50 guinea pigs monitored, only 6% of them reacted positively to sevoflurane gas exposure, while most of them, 94%, were negative. This result implied that for every 16 guinea pigs, 1 may react to sevoflurane gas exposure. The average body temperature of the sevoflurane positive kits was 38.9 ° C, ranging between 38.7 and 39.1 ° C and the average body temperature of the negative kits was 37.9, varying between 37.2 and 38.5 ° C. Similar values have been reported by Chancafe (2019) who determined a temperature range; between 37.2 - 39.5 ° C. Likewise, other investigations such as those of Pardo (2016) and INIA (2005) indicate biological data of an average temperature (38.6 ° C) and oscillating between 37.2 - 39.5 ° C.

Breathing frequency

The sevoflurane positive kits had an average of 142.3 breaths per minute while the negative kits had an average of 83.7; ranging from a minimum value of 61 to a maximum of 111 breaths per minute. Similar values were established by Chancafe (2019) with an average of 90 breaths per minute, varying from 69 to 104 respiratory movements per minute. In the same way, INIA (2005), Pardo (2016) mention that this biological characteristic has values of 40 - 150 breaths per minute.

Heart rate

It was determined that the kits with a positive reaction to sevoflurane had an average of 205 heart beats per minute, while, in the kits with a negative reaction, the heart rate ranged between 87 and 159, with an average of 119.5 beats per minute. These results agree with those established by INIA (2005), which calculated a value of this physiological variable in the Peruvian breed of 130 - 190 beats per minute. But they are much lower than those reported by Chancafe (2019) who points out that the average heart rate is 275 beats per minute with a range of 150-400 beats per minute. In the same way, it does not agree with Pardo (2016) who gives us the value of the heart rate of 190-300 beats per minute.

CONCLUSION

It is concluded that for every 16 guinea pigs, one will react to the sevoflurane gas exposure positive due to the result obtained from the vital sign. Only the positive ones presented muscle tremors.

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