EVALUATION OF TEMPERATURE MEASUREMENTS ON CATS USING DIGITAL, MERCURY AND TYMPANIC INFRARED THERMOMETERS

AVALIAÇÃO DA MENSURAÇÃO DA TEMPERATURE DE GATOS UTILIZANDO OS TERMÔMETROS DIGITAL, DE MERCÚRIO E TIMPÂNICO INFRAVERMELHO

SUMARY

With a view to reducing stress and discomfort and improving the practicality of making temperature measurements on cats, the aim of this study was to evaluate the use of a tympanic infrared thermometer (TIT), which is an easy-to-use device for measuring temperatures quickly, comfortably and more hygienically. For this, were selected 120 domestic cats living in Sousa, Paraíba, northeastern Brazil. Among them, 100 were normothermic, ten were hypothermic and ten were hyperthermic. None of them had any clinical signs of external or internal otitis. The measurements using the digital thermometer were higher than those using the TIT ($P < 0.05$), in the normothermic and hyperthermic cats. In the hypothermic cats, there was no difference ($P \geq 0.05$) in mean values from the three types of thermometer. The values obtained using the mercury thermometer did not differ ($P \geq 0.05$) from the values obtained using the other thermometers. There was a strong positive correlation in almost all the evaluations between the three thermometers, except for digital versus TIT for hyperthermic cats ($r < 0.75$). Because of the discrepancy between the values obtained by the TIT and the digital rectal thermometer, we suggest that further studies should be carried out in order to establish a temperature correction table for the TIT, so that it can be better used in veterinary medicine.

Keywords: felines, hyperthermic, hypothermic, normothermic, ear thermometer.

RESUMO:

Com o objetivo de reduzir o estresse, desconforto e melhorar a praticidade da medição da temperatura em gatos, o objetivo deste estudo foi avaliar o uso de um termômetro timpânico infravermelho (TTI), que é um dispositivo de fácil utilização para medição de temperatura de forma rápida, confortável e higiênica. Para isso, foram selecionados 120 gatos domésticos criados no município de Sousa, Paraíba, Nordeste do Brasil. Dentre eles, 100 eram normotérmicos, dez hipotérmicos e dez hipertérmicos. Nenhum deles apresentava sinais clínicos de otite externa ou interna. As temperaturas mensuradas pelo termômetro digital foram superiores às do TTI ($P < 0,05$) nos gatos normotérmicos e hipertérmicos. Nos gatos hipotérmicos, não houve diferença ($P \geq 0,05$) nos valores médios dos três tipos de termômetro.

Os valores obtidos com o termômetro de mercúrio não diferiram ($P \geq 0,05$) dos valores obtidos com os demais termômetros. Houve forte correlação positiva em quase todas as avaliações entre os três termômetros, exceto para digital versus TIT para gatos hipertérmicos ($r < 0,75$). Devido à discrepância entre os valores obtidos pelo TIT e o termômetro retal digital, sugere-se que mais estudos sejam realizados a fim de se estabelecer uma tabela de correção de temperatura do TIT, para que possa ser melhor utilizado na medicina veterinária.
Palavras-chave: felinos, hipertérmico, hipotérmico, normotérmico, termômetro auricular.

INTRODUCTION

The measurement of body temperature is the first and significant part of the hands-on clinical examination and provides information that helps disease diagnosis (SMITH et al., 2015). Rectal temperature measurement in animals, especially in cats, is often difficult in veterinary practice, due to the discomfort caused by this type of verification. Animals tend to difficult the rectal mercury or digital thermometers, impairing their clinical evaluation, in addition to the risk of injury to the mucosa and physical trauma to both the animal and the handler (BOERE & MAZZOTTI, 2009). Rectal temperature measurement also presents questions of reliability and safety, as the presence of feces can provide erroneous data on the animals' temperature, leading the veterinarian to therapeutic protocol mistakes (SMITH et al., 2015).

In order to ensure animal welfare, methods of body temperature measurement that reduce stress, damage and injuries are sought, for the sake of both the handler and the animals. One alternative is to use a tympanic infrared thermometer (TIT) (BOERE & MAZZOTTI, 2009; PAZ et al., 2017). This is an easy-to-use device for measuring temperature quickly and conveniently that is widely used in human pediatric clinics, where it has shown good results (MACHADO & ANDRADE, 2009).

A disadvantage of using the TIT is that if measurements are made on animals with otitis, the presence of this condition may produce temperature readings that differ from the real body

temperature, given that this condition consists of inflammation of the ear canal, with increased temperature (NASCENTE, 2006).

In veterinary medicine, TIT is increasingly used (CUGMAS et al., 2020). This technology involves use of pyroelectric sensors to detect the heat emanating from the tympanic membrane and inner surface of the external ear canal to obtain a more accurate measurement of core body temperature (FRADEN, 1991). However, there is a scarcity of studies that might indicate whether the temperatures provided by this thermometer can be interpreted in accordance with the values available in the literature for rectal temperatures in cats (FEITOSA, 2014). Another important factor is that cats have a large amount of innervation and vessels in their ears, which can influence temperature measurements from the tympanic membrane (SMITH et al., 2015). Therefore, the aim of study was to evaluate the accuracy of the TIT in comparison with use of mercury and digital thermometers in the rectum, for measuring the temperature of normothermic, hypothermic and hyperthermic cats.

MATERIAL AND METHODS

Animals

For convenience, 120 domestic cats living in the municipality of Sousa, state of Paraíba, northeastern Brazil were selected. They comprised 100 normothermic, ten hypothermic and ten hyperthermic cats of both sexes and different breeds and ages, without any clinical signs of external or internal otitis. The normothermic cats were healthy and their temperature measurements were made at their homes. The hypothermic and hyperthermic cats had their temperatures measured during routine visits to the Veterinary Hospital of the Instituto Federal de Educação, Ciência e Tecnologia da Paraíba (IFPB), Sousa campus.

88 **Temperature measurements**

89 In order to measure the tympanic temperature, an infrared thermometer[1] (accuracy ± 0.2
90 °C) was used. The auricle was raised, to produce better alignment of the vertical and horizontal
91 auditory channels, thus enabling detection of infrared energy emanating from the tympanic
92 membrane and the outer ear around the inner channel.

93 To measure the rectal temperature, a mercury column thermometer[2] (accuracy –0.15 +
94 0.1 °C) was used, introduced into the rectal mucosa for two minutes. Immediately after this, a
95 digital electronic thermometer[3] (accuracy ± 0.2 ºC) was used. This was inserted into the wall of
96 the rectal mucosa, was activated and was then kept there until an audible signal was emitted.
97 The mean duration of the evaluation, from the first to the last measurement, was around four
98 minutes per animal.

99 This research was approved by the Ethics Committee for Use of Animals (CEUA), of the
100 IFPB, under approval number 23798.000725.2019-92.

101

102 **Statistical analysis**

103 The data were evaluated using Minitab 19[4]. Comparisons between the thermometers were
104 made using one-way analysis of variance (ANOVA) and Tukey's test at a 5% probability level.
105 Pearson's correlation coefficient (r) was used to evaluate correlations between the three
106 thermometers in this study (MINITAB, 2019) and $r \geq 0.75$ was considered POSITIVE
107 (KUNKLE et al., 2004).

108

109 **RESULTS**

110 There were statistically significant differences ($P < 0.05$) in the mean temperatures
111 measured in both normothermic and hyperthermic animals, between the measurements made
112 using the digital thermometer (higher values) and the TIT (lower values) (Table 1). In the

hypothermic cats, there was no statistically significant difference ($P \geq 0.05$) in the mean values from the three types of thermometers. It was also observed that the values obtained using the mercury thermometer did not differ ($p \geq 0.05$) from the values obtained using the other thermometers.

There was a strong positive correlation in almost all the evaluations between the three thermometers, except for digital versus TIT for hyperthermic cats ($r < 0.75$) (Table 2).

DISCUSSION

For normothermic and hyperthermic cats, the measurements using the digital thermometer were approximately 0.4 ºC higher than those obtained using the TIT. This does not imply that the TIT is inaccurate, but that for better use to be made of the TIT, a temperature correction table is needed. There were evaluated temperatures in goats, sheep and horses and observed that in all cases rectal temperatures were significantly higher than tympanic temperatures that were determined through using an infrared thermometer (GOODWIN, 1998). A study compared tympanic temperature and the rectal temperature of 41 normothermic cats and also found that the rectal temperature was higher. These authors suggested that the non-equivalence between the temperatures of the tympanic membranes and the rectum might be due to the anatomical and physiological characteristics of these body regions, which could generate significant differences (BOERE & MAZZOTTI, 2009).

In five hypothermic cats, it was not possible to measure their temperature using the mercury thermometer, because they had a rectal temperature below 35 ºC. The graduation scale for temperature measurements using this type of thermometer only start at 35 ºC (MCCOLL et al.,2013). This makes it difficult to monitor patients at times like the immediate postoperative period, as was the case of these hypothermic cats in the present study.

A low correlation ($r < 0.75$) was observed between the digital thermometer and TIT in relation to the hyperthermic cats. Similar results were found in a comparison between a digital thermometer and TIT at temperatures that are considered to be febrile (> 39.2 °C), showed an even weaker correlation (KUNKLE et al., 2004).

However, despite the temperature differences observed, we found that the TIT was easy and convenient to use for cats. This method provided a temperature measurement within seconds, in contrast to the minutes that are required the rectal temperature measurement.

CONCLUSION

There was non-equivalence between the temperatures measured using the tympanic infrared thermometer (TIT) and the digital thermometer in hyperthermic and normothermic cats. However, the TIT was efficient for measuring the temperature in hypothermic cats, since its measurement capacity covers low values that digital and mercury thermometers cannot detect. We believe that further studies are needed, in order to develop a table with reference and equivalent values for implementing use of this infrared thermometer within routine veterinary medical practice.

MANUFACTURERS

[1]Motorola. Kowloon, Hong Kong, China.

[2]Incoterm. Porto Alegre, RS, Brazil.

[3]G-tech[3]. Austin, TX, USA.

[4]Minitab LLC. State College, PA, USA.

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Table 1. Averages and standard deviations of the temperatures of normothermic, hypothermic and hyperthermic cats, obtained through measurements made consecutively using the digital, mercury and tympanic infrared thermometers.

	Normothermic cats		Hypothermic cats		Hyperthermic cats	
Thermometers	N	Mean ± SD (ºC)	N	Mean ± SD (ºC)	N	Mean ± SD (ºC)
Digital	100	37.93 ± 0.73[a]	10	34.90 ± 0.26[a]	10	39.70 ± 0.18[a]
Mercury	100	37.77 ± 0.79[ab]	5	35.10 ± 0.17[a]	10	39.53 ± 0.33[ab]
Tympanic infrared	100	37.55 ± 0.71[b]	10	34.94 ± 0.14[a]	10	39.27 ± 0.29[b]

SD: Standard deviation; N: number of animals. Values followed by different letters in the same columns differed statistically ($p < 0.05$), according to Tukey's test.

Table 2. Correlation coefficients (r) for the mean temperatures of normothermic, hypothermic and hyperthermic cats, obtained through measurements made consecutively using digital, mercury and tympanic infrared thermometers.

	Correlation coefficient (r)		
Thermometers	Normothermic	Hypothermic	Hyperthermic
Digital versus Mercury	0.880	0.755	0.863
Digital versus Tympanic infrared	0.803	0.816	0.652
Mercury versus Tympanic infrared	0.789	0.760	0.768