# DO NASAL DILATORS IMPROVE ENDURANCE PERFORMANCE IN HORSES SUBMITTED TO A 20 KM RUN?

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**ABSTRACT**

The aim of this study was to identify the effect of external nasal dilator strips (ENDS) on the physiologic parameters of equines submitted to a sub maximal exercise test under field conditions. Six healthy athletic horses trained to 20 km endurance competition were used. All animals participated in both groups, NodiG (without nasal dilator) and WidiG (with nasal dilator) with a one week wash out period. They were randomized to determine the starting group. Sub-maximal exercise was performed at 5.5 m/s for a distance of 20 km over one hour. Hour of day, rider and track were always the same for all horses. Physiologic parameters measured included heart and respiratory rates, as well as blood lactate levels. These were measured at rest (T0), after 10 km (T1), after 20 km (T2), and 30 minutes after the end of the exercise (T3). Heart and respiratory rates were significantly greater related to exercise, with both groups showing differences when comparing T0/T1, T0/T2, T1/T3 and T2/T3. Blood lactate levels exhibited a different pattern, showing significant differences in values between T0/T1, T0/T2 and T0/T3 in NodiG and WidiG. No variable was affected by ENDS in any of the equines. Conclusion. The results demonstrate that ENDS does not improve aerobic capacity in endurance horses.

KEY WORDS: Blood lactate, equine, heart rate, nasal strip.

**RESUMO**

DILATADORES NASAIS MELHORAM A PERFORMANCE DE CAVALOS DE ENDURO SUBMETIDOS A PERCURSO DE 20 KM?

Objetivo. O objetivo deste estudo foi identificar o efeito do dilatador nasal externo (DNE) sobre parâmetros fisiológicos de equinos submetidos a exercício submáximo a campo. Utilizaram-se seis cavalos atletas treinados para provas de vinte quilômetros. Os animais participaram de ambos os grupos, NodiG (sem dilatador nasal) e WidiG (com dilatador nasal) com uma semana de intervalo. Eles foram divididos aleatoriamente para definir o grupo em que começariam o primeiro teste. Realizou-se o teste a campo a 5,5 m/s durante uma hora, percorrendo vinte quilômetros ao todo. Hora do teste, cavaleiro e pista foram sempre os mesmos para todos os animais e momentos. As variáveis fisiológicas avaliadas foram frequências cardíaca e respiratória e lactato sanguíneo em repouso (T0), após dez quilômetros (T1) e vinte quilômetros (T2) e minutos minutos após o final do teste (T3). As frequências cardíaca e respiratória foram maiores de acordo com o exercício em ambos os grupos, mostrando valores diferentes entre T0/T1, T0/T2, T1/T3 e T2/T3. O lactato sanguíneo apresentou um padrão diferente das demais variáveis, com valores maiores entre T0/T1, T0/T2 e T0/T3 também para ambos os grupos. Nenhuma variável foi afetada pelo dispositivo em todos os equinos. Os resultados mostraram que o DNE não melhorou a capacidade aeróbica em cavalos de enduro.

PALAVRAS-CHAVES: Dilatador nasal, equinos, frequência cardíaca, lactato sanguíneo.

## INTRODUCTION

External nasal dilator strip (ENDS) devices have been recently studied as a non pharmacologic option to improve oxygen flow in human beings and equines during competition (GEHRING et al., 2000; VALDEZ et al., 2004). The equine nasal strip is a self-adhesive, thin strip embedded with three flexible pieces with spring like action. Its purpose is to maintain open nasal passages to maximize airflow (GOETZ et al., 2001).

According to some authors, the use of this device results in lower nasal airway resistance secondary to dilation of the vestibule and nasal valve (GRIFFIN et al., 1997). Decreases in airway resistance of 23% have been reported (GEHRING et al., 2000; HOLCOMBE et al., 2002). However, these findings are controversial, with some authors reporting no effects (GOETZ et al., 2001). ENDS use may also be associated with a reduction in the changes of intra-pleural and alveolar pressures of running horses. These changes may contribute to high pulmonary capillary trans-mural pressures and exercise induced pulmonary hemorrhage (EIPH). Although, considered controversial by some authors (POOLE et al., 2000; VALDEZ et al., 2004), the results of a study performed by McDONOUGH et al. (2004), showed that furosemide and ENDS had the same effect in reducing time-to-fatigue and EIPH in thoroughbreds during high-speed treadmill running.

Currently, field exercise tests are being performed frequently. These tests have the ability to simulate real muscle, respiratory and cardiovascular efforts in equine athletes (EVANS, 2007). Blood lactate and heart rate are most often used to evaluate the physical performance of horses (SERRANO et al., 2002; ANGELI & LUNA, 2008). Blood lactate is used to predict endurance performance in horses, considering different methods (TRILK et al., 2002; GONDIM et al., 2007; ANGELI & LUNA, 2008). However, in human being studies, lactate threshold was shown to be unaffected by ENDS during moderate to high-intensity exercise (BOGGS et al., 2008).

ENDS has not been tested in endurance horses. For this reason, this study aims to identify the effect of external nasal dilator strips on the physiologic parameters of endurance horses submitted to a sub maximal exercise test under field conditions.

## MATERIAL AND METHODS

The experiment was carried out on six healthy athletic horses (three females and three geldings), trained to 20 km endurance competition, ranging from five to nine years of age (7±2) and weighing 350±30 kg. All animals received the same food/vaccine/Ferrier and veterinary health protocol. Animals were randomized to the two groups in the first evaluation: NodiG (without nasal dilator) and WidiG (with nasal dilator). All horses participated in both groups, with a one week wash out period. The protocol was approved by the Ethical Research Committee of the Tuiuti University of Paraná.

The ENDS utilized in the present study are a commercial product (Flair Equine Nasal Strips – CNS), available in only one size for horses.

The nasal area was cleaned with an alcohol pad before the application of ENDS. The area was not clipped. They were placed in accordance with the manufacturer's directions, which specify that the device should be positioned 3.81 cm (1.5 in.) above the top edge of the nostrils (Figure 1).

**FIGURE 1.** Photograph showing the position of the nasal strip over the horse nose.

## Exercise protocol and evaluated variables

Sub-maximal exercise was performed at 5.5 m/s for a distance of 20 km over one hour. The tests were performed in the morning starting at 8 AM. The rider and the track were the same for all horses. Velocity was controlled using a Global Positioning System device by rider and a chronometer by the evaluator. The physiologic parameters measured were heart and respiratory rates, and blood lactate levels. These were measured at rest (T0), after a 10 km distance (T1), after a 20 km distance (T2) and 30 minutes after the end of exercise (T3).

The heart rate was recorded using a heart monitor device[1] and the respiratory rate was obtained using a regular stethoscope[2], by the same evaluator. Blood was collected from the jugular vein using a 21 gauge needle and a 3 ml syringe, one minute after the 10 km and 20 km exercise and 30 minutes after the end of exercise. Lactate was measured using a portable device[3].

1. Equine Health Check. Polar®
2. Cardiology Stethoscope. Littmann®
3. Accutrend Lactate. Roche®

All statistics were performed using Statistica 6.0 for Windows (Statistical Solutions, Sugus, MA). All data throughout are expressed as means ± standard deviation, including figures. A one-way analysis of variance for repeated measures was utilized to determine if differences existed between moments (T0, T1, T2 and T3) and groups (NodiG and WidiG). When significance was revealed, the point of significance was identified using a Student–Newman–Kuels *post hoc* test. Statistical significance was pre-selected to correspond to a P value < 0.05.

## RESULTS

Heart rate was significantly greater related to exercise for both groups. Values of heart rate were 32.6±4.5 at T0, 89.8±8.6 at T1, 93.1±13.4 at T2 and 39.6±5.4 at T3 for the NodiG group. For the WidiG group values were 33.8±4.7 at T0, 92.1±14.6 at T1, 86.8±9.5 at T2 and 37.3±3.5 at T3. Significant differences were found when comparing values: T0/T1, T0/T2, T1/T3 and T2/T3 in both groups (Figure 2).

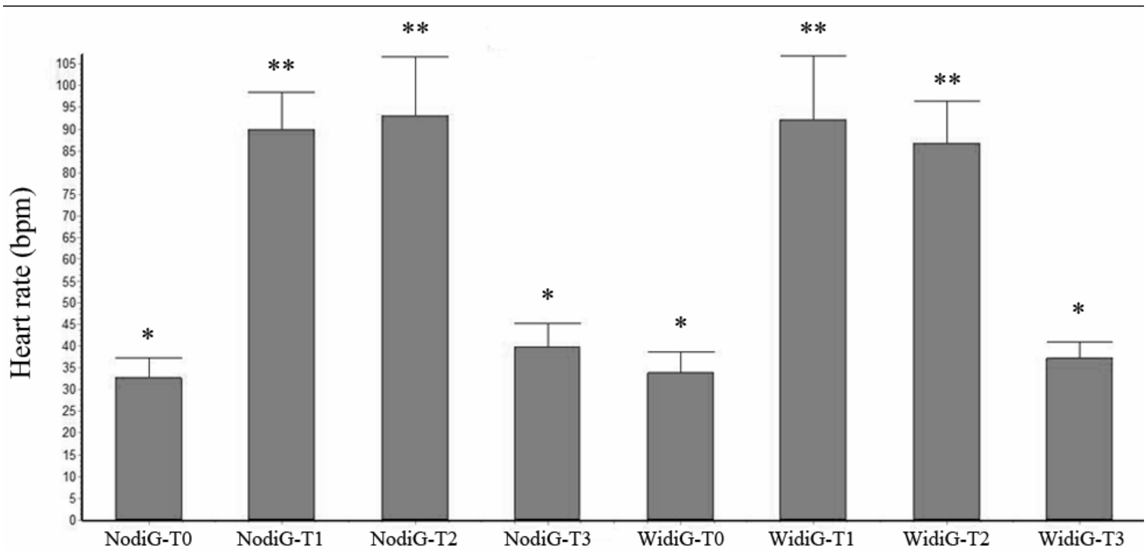


**FIGURE 2.** Graphic showing heart rate pattern for both groups (NodiG and WidiG) during T0 (at rest), T1 (immediately after 10 km), T2 (immediately after 20 km)) and T3 (30 min after 20 km). Two asterisks indicate P values < 0.05. Significant differences between times were affected only by the exercise variable.

Respiratory rate had the same pattern described above. Values were 17.3±4.3 at T0, 68±29.5 at T1, 59.8±17.7 at T2, and 23.3±3.9 at T3 for the NodiG group. Values for the WidiG group were 21.8±8 at T0, 72.1±23 at T1, 56.3±22.1 at T2, and 22.6±4.8 at T3. Statistically significant differences were found when comparing values: T0/T1, T0/T2, T1/T3 and T2/T3 for both groups (Figure 3).

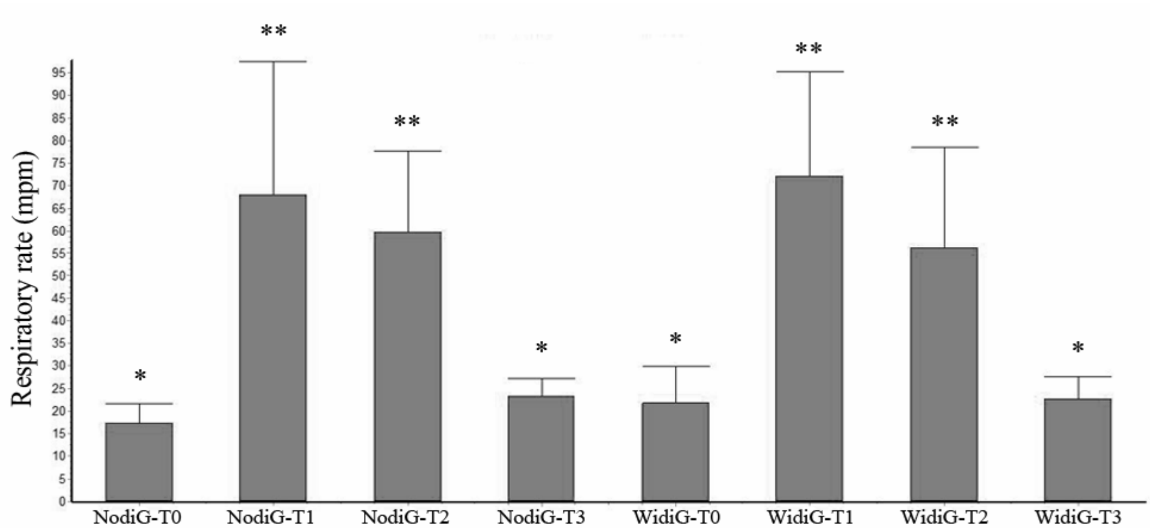


**FIGURE 3.** Graphic showing respiratory rate pattern for both groups (NodiG and WidiG) during T0 (at rest), T1 (immediately after 10 km), T2 (immediately after 20 km)) and T3 (30 min after 20 km). Two asterisks indicate P values < 0.05. Significant differences between times were affected only by the exercise variable.

Blood lactate demonstrated a pattern different from heart and respiratory rates. It was statistically greater between T0/T1, T0/T2 and T0/T3 for both groups. Values were 1.3±0.3 at T0, 2.4±0.7 at T1, 2.4±0.5 at T2 and 2±0.4 at T3 for the NodiG group. For the WidiG group, values were 1.2±0.2 at T0, 2.3±0.7 at T1, 2.3±0.9 at T2 and 2±0.7 at T3 (Figure 4). All data are expressed on Table 1.

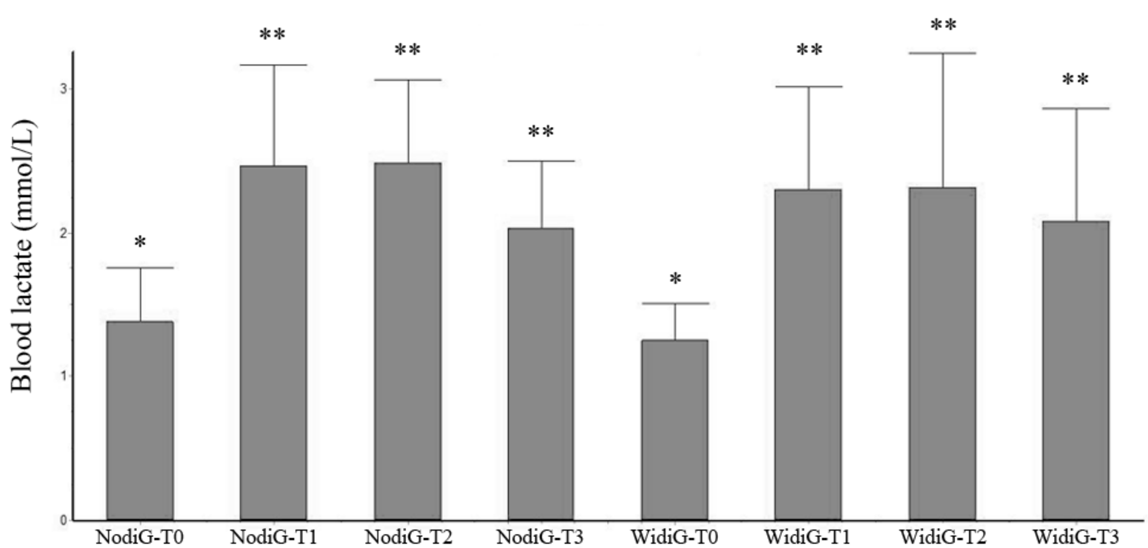


**FIGURE 4.** Graphic showing blood lactate pattern on both groups (NodiG and WidiG) during T0 (at rest), T1 (after 10 km), T2 (immediately after 20 km)) and T3 (30 min after 20 km). Two asterisks indicate P values < 0.05. Significant differences between times were affected only by the exercise variable.

**TABLE 1**. Absolute numbers for heart rate, respiratory rate and blood lactate for both groups (NodiG and WidiG) during T0 (at rest), T1 (immediately after 10 km), T2 (immediately after 20 km) and T3 (30 min after 20 km) for animals (A) 1, 2, 3, 4, 5 and 6.

| Heart rate (bpm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NodiG | | | | | WidiG | | | | |
| | T0 | T1 | T2 | T3 | | T0 | T1 | T2 | T3 |
| A1 | 32 | 84 | 70 | 38 | A1 | 33 | 77 | 72 | 36 |
| A2 | 32 | 82 | 97 | 38 | A2 | 30 | 80 | 95 | 34 |
| A3 | 26 | 91 | 86 | 34 | A3 | 27 | 83 | 92 | 35 |
| A4 | 40 | 102 | 109 | 50 | A4 | 40 | 115 | 97 | 38 |
| A5 | 34 | 98 | 100 | 40 | A5 | 37 | 100 | 83 | 37 |
| A6 | 32 | 82 | 97 | 38 | A6 | 36 | 98 | 82 | 44 |
| Respiratory rate (mpm) | | | | | | | | | |
| NodiG | | | | | WidiG | | | | |
| | T0 | T1 | T2 | T3 | | T0 | T1 | T2 | T3 |
| A1 | 10 | 38 | 40 | 16 | A1 | 17 | 75 | 32 | 16 |
| A2 | 20 | 50 | 60 | 26 | A2 | 16 | 46 | 60 | 30 |
| A3 | 14 | 104 | 44 | 22 | A3 | 34 | 60 | 90 | 24 |
| A4 | 20 | 106 | 90 | 26 | A4 | 30 | 104 | 71 | 22 |
| A5 | 20 | 60 | 65 | 24 | A5 | 18 | 54 | 50 | 19 |
| A6 | 20 | 50 | 60 | 26 | A6 | 16 | 94 | 35 | 25 |
| Blood lactate (mmol/L) | | | | | | | | | |
| NodiG | | | | | WidiG | | | | |
| | T0 | T1 | T2 | T3 | | T0 | T1 | T2 | T3 |
| A1 | 1.3 | 2.1 | 1.9 | 2.1 | A1 | 0.9 | 1.6 | 0.9 | 1.0 |
| A2 | 1.7 | 2.4 | 3.0 | 2.4 | A2 | 1.5 | 2.0 | 2.8 | 2.1 |
| A3 | 0.9 | 2.8 | 2.4 | 1.5 | A3 | 1.4 | 2.3 | 3.3 | 2.7 |
| A4 | 1.7 | 3.6 | 2.9 | 2.4 | A4 | 1.5 | 3.0 | 3.1 | 3.2 |
| A5 | 1.0 | 1.5 | 1.7 | 1.4 | A5 | 1.1 | 1.6 | 1.6 | 1.6 |
| A6 | 1.7 | 2.4 | 3.0 | 2.4 | A6 | 1.1 | 3.3 | 2.2 | 1.9 |

## DISCUSSION

Endurance exercise predominantly utilizes aerobic metabolism during muscle contraction. Endurance horses can run up to 160 km in less than 15 hours (TRILK et al., 2002). Hence, everything that can improve oxygen delivery to muscles should increase performance. It is hypothesized that by decreasing respiratory work ENDS may decrease the oxygen necessity of respiratory muscles; consequently, more oxygen is available for other muscles during exercise.

Airflow resistance falls due to sympathetic vasoconstriction on nasal mucosa. This effect has been observed up to 30 minutes after exercise (GOETZ et al., 2001) and for this reason animals were evaluated 30 minutes after the effort. Endurance competitions are a sub maximal exercise, having less adrenaline release and lactate values, when compared to other sports with greater velocity (TRILK et al., 2002). Maybe, that is the reason it was not possible to identify any effect from the ENDS device in this research.

In a human study (GEHRING et al., 2000), ENDS effects were observed during rest, demonstrating responsive individuals and non responsive individuals. In our study, this pattern was not observed in endurance horses at rest or during exercise. Our results are similar to what GOETZ et al. (2001) found in thoroughbreds. The difference is likely due to the morphophysiological characteristic of the horses' nose .Our study found no significant change in blood lactate levels; the reason for this is unknown. No report of dynamic collapse of lateral nasal wall in equines has been published during extenuating and sub maximal exercises (GOETZ et al., 2001). Also, according to OVEREND et al. (2000), no effect of ENDS was observed in human beings wearing mouth guards, while performing maximal or sub maximal exercise. Guards used to prevent mouth breathing in humans, simulates breathing in horses, who, are anatomically obligate nose breathers.

ENDS decreases nasal resistance in exercising horses (HOLCOMBE et al., 2002). The device may have caused insufficient changes on the physiologic parameters evaluated in our research. Some studies have demonstrated the benefits of ENDS in bleeders (McDONOUGH et al., 2004; VALDEZ et al., 2004). Most likely, the device only works in extreme exercise situations in equines, not in sub maximal exercises as performed in our research.

Considering the exercise protocol performed by all the animals, the pattern of heart, respiratory rates and blood lactate showed expected results (SERRANO et al., 2002; TRILK et al., 2002; GONDIM et al., 2007). Our results did not demonstrate the effects of ENDS, as described by other authors (BOGGS et al., 2008; GOETZ et al., 2001).

The portable lactate device utilized to measure blood lactate under field conditions has been used in horses (ANGELI & LUNA, 2008), and it is reliable when the values are below 10 mmol/L (EVANS & GOLLAND, 1996; EVANS, 2007). According to our findings, this method is appropriate to evaluate endurance horses under field conditions, especially because it allows immediate and repetitive evaluations.

Elevated lactate values continued up to 30 minutes after exercise, showing the same pattern found in thoroughbreds also submitted to sub maximal exercise (ANGELI & LUNA, 2008), and was not influenced by ENDS. Our findings did not permit us to conclude whether the application of an external nasal dilator strip decreases nasal resistance to airflow in horses.

It is important to note that ENDS was detached in all animals one hour after the start of exercise. The influence of sweat on ENDS indicated that the device was not well suited to remain in place, preventing longer running periods. Regardless of this fact, ENDS should be tested other distances in endurance horses.

## CONCLUSIONS

Our goal was to determine if the use of an external nasal dilator would improve aerobic exercise in endurance horses. The results showed that ENDS did not afford these benefits.

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