Postponement of Musth in Asian Elephants Using a GnRH Vaccine

T. M. S. K. Piyadasa[1], Ashoka Dangolla[1]*, Chandana Rajapakshe[2], Eranda Rajapakshe[1], Neil Horadagoda[3], P. G. Anil Pushpakumara[4] and Peter Windsor[5]

[1]*Department of Veterinary Clinical Science, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*Pinnawela Elephant Orphanage, Rambukkana, Sri Lanka*
[3]*University Veterinary Teaching Hospital Camden, New South Wales, Australia*
[4]*Dept. of Farm Animal Production and Health, University of Peradeniya, Peradeniya, Sri Lanka*
[5]*Faculty of Veterinary Science, University of Sydney, Camden, NSW, Australia*
**Corresponding author's e-mail: adangolla@gmail.com*

Introduction

In Sri Lanka and in other Asian countries, mature male captive Asian elephants (*Elephas maximus*) are an integral part of celebrations related to cultural, religious and state occasions. However, the annually occurring musth period of adult males (Fig. 1) may hinder sourcing of elephants for these events (Lincoln & Rathnasooriya 1996; Jainudeen *et al*. 1972).

Musth in mature males is a testosterone dependent (Rasmussen *et al*. 2008), highly predictable event, which lasts between 3–6 months. When in musth, privately owned captive males are kept tethered in stables (Ananth 2000; Rajapaksha *et al*. 2004). During this period male elephants can be difficult to handle and often are aggressive to the point that they may injure handlers and in some instances, even kill them (Pool 1989; Rasmussen & Perrin 1999).

Endocrinologically, the mean normal serum testosterone concentrations in captive Asian male elephants vary from 1–10 ng/ml while in pre-musth and musth, the levels are 10–20 ng/ml and 20–50 ng/ml, respectively (Yon *et al*. 2008). During musth, bull elephants show marked increase in testosterone secretion and studies have shown high sensitivity of the testes to GnRH during the non-musth period (Somgird *et al*. 2016).

Controlling and monitoring the aggressive behaviour of captive male elephants during musth is of paramount importance not only from a public safety perspective but also from an animal welfare standpoint. De Nys *et al*. (2010) were able to reduce musth-related aggression by surgical castration. However, as elephants have intra-abdominal testes, this procedure is difficult, costly and irreversible. The use of anti-androgens, oestrogens (Hettiarachchi *et al*. 2005), GnRH agonists, and GnRH antagonists also has limited value due to unpredictable results and practical difficulties in administration.

De Nys *et al*. (2010) and Talwar *et al*. (1995) suggested the use of GnRH vaccine to down-regulate the hypothalamic-pituitary-gonadal axis, as noted in several other species of animals (Miller *et al*. 2000), which could be a useful, reversible (Miller *et al*. 2000) and a relatively inexpensive procedure to suppress musth in elephants. No detrimental effects of this vaccine on elephants have been reported.

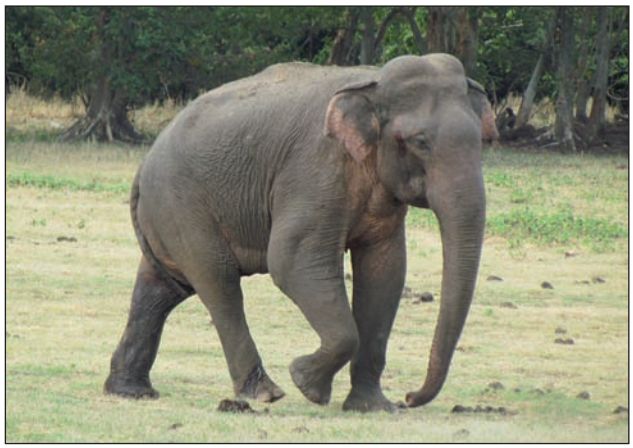

Figure 3. Wild musth bull in Minneriya National Park. Note the secretion from its temporal gland and the wet hind legs from urine dribbling. Photo by Jennifer Pastorini.

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The objective of this study was to investigate the effects of GnRH vaccine in the postponement of musth in captive male elephants.

Methods

Four privately owned males and two males from Pinnawela Elephant Orphanage were selected for the study. For musth suppression, three doses of GnRH vaccine (800 μg per dose; BOPRIVA®bovine immune castration vaccine, Zoetis GMS Australia) was injected IM at monthly intervals so that the last injection was approximately one month prior to the anticipated date of musth.

At the time of each vaccination, blood samples were collected from the ear vein, the serum separated and stored at -20ºC until analysis. Testosterone levels were assessed using an Enzyme-Linked Immuno Sorbent Assay.

Elephant owners and handlers were educated on musth, its undesirable effects and potential threat to public safety and the effect of musth postponement by GnRH vaccine was explained (Fig. 2). The elephant keepers were asked to keep a note on the behaviour i.e. obedience, of the elephants in their care.

Results

Of the four privately owned elephants, all three doses were given to one elephant, two doses to each of two elephants and a single dose to one elephant (Table 1). The full course could not be

Figure 2. Explaining the procedure to the mahout before vaccination.

Table 1. Animals included in the study, dates of vaccinations, serum testosterone levels (STL), anticipated and onset dates of musth. NV = not vaccinated; NR = not recorded.

Ownership	Elephant	End of last musth	Expected next musth	Onset of musth	Vaccination date and STL [ng/ml]					
					1st dose		2nd dose		3rd dose	
					Date	STL	Date	STL	Date	STL
Private	Saliya	15.3.2014	5.7.2014	27.9.2014	15.4.2014	2.96	19.5.2014	2.37	19.6.2014	0.68
	Udaya	5.11.2013	15.7.2014	7.7.2014	29.4.2014	9.19	29.5.2014	0.82	NV	NR
	Tharaka	20.10.2013	19.4.2014	11.3.2014	4.2.2014	NR	4.3.2014	NR	NV	NR
	Ranji	15.2.2014	5.10.2014	20.8.2014	15.7.2014	24.52	NV	NR	NV	NR
Pinnawela	Jayathu	Continuous for two years	Unpredictable	5.12.2014	22.9.2013	1.52	24.10.2013	3.87	22.11.2013	4.97
	Suranimala	Irregular, twice a year	Unpredictable	25.1.2015	25.1.2014	15.70	4.3.2014	9.22	25.3.2014	2.03

given to all as the owners and keepers did not comply with the injections and advice. Blood samples could not be collected from Tharaka, one of the privately owned males because he was aggressive and a new keeper had been employed.

The elephant receiving all three doses demonstrated a three-month delay in the onset of musth (Table 1), together with a marked reduction in aggressiveness. The two elephants that received two doses showed signs of musth around the expected time, however, there was a reduction in aggression. The animal that received a single dose came into musth two months prior to the expected date with higher aggression and had a prolonged period of musth.

Of the two Pinnawala elephants, one had been in continuous musth for almost two years when the first dose was administered and he came out of musth immediately after the first injection and had lowered aggression. However, musth reappeared approximately 13 months after the third dose (Table 1). The other had a history of irregular musth twice a year and responded by delayed commencement of musth by approximately 10 months after the third dose (Table 1), with lowered aggression.

Testosterone levels were reduced in two of the four privately owned elephants in which all tests were done and one of the Pinnawala elephants while the other Pinnawala elephant showed an increase in testosterone levels (Table 1).

Discussion

This is the first time that the vaccine was used on privately owned captive elephants in Sri Lanka. One elephant with a typical history of musth, given three doses of GnRH vaccine, responded with decrease in serum testosterone levels, postponement of musth, and decrease in aggressiveness.

A high serum testosterone level at the time of the first vaccination may be associated with eliciting a good response to the course of injection, as seen by the delay in musth and reduced aggression, by elephants Saliya and Suranimala. In three of four animals tested, the serum testosterone level declined after the vaccinations. Privately owned male elephants have an assigned keeper for several years, while in the Pinnawela Orphanage, this is not the case. Although musth is essentially testosterone dependent, the elephant-keeper relationship could possibly influence the behaviour during musth (Hettiarachchi *et al*. 2005), which may have had an effect on levels of aggression observed in this study.

In Thailand five bulls vaccinated with 600 μg GnRH two months before expected musth and boosted three times with 600 μg at four week intervals, showed decreased serum testosterone levels with musth postponement in three and skipping of musth for that year in the other two (Somgird *et al*. 2016). In Sri Lanka, three of six bulls given 600 μg GnRH, in three injections one month apart, showed reduced serum testosterone levels while others did not show anticipated response (Rajapaksa *et al*. 2010).

Unpredictable behaviour in male elephants can be seen even naturally when serum testosterone decreases after the peak in musth (Lincoln & Ratnasooriya 1996). Therefore elephant keepers must be made aware that, though GnRH is likely to postpone musth, the length of post-musth period could vary. Some elephant owners in Sri Lanka believe that disruption of musth in healthy males leads to intractable handling difficulties (Rajaram 2006). In this study, an attempt was made to address this belief by education to the contrary. However, this may have been the reason for non-compliance by two of the privately held

Figure 3. Vaccination of a captive bull.

elephant owners in completing the three doses of vaccine. Incentives such as service priorities and discounts in professional costs may help increase compliance.

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