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Effect of intravenous regional anaesthesia (IVRA) using lignocaine hydrochloride with or without modified standing stun on serum cortisol and behavioural changes during therapeutic hoof trimming in dairy cattle#

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Abstract

The study was conducted in postpartum lactating dairy cows to compare the effect of intravenous regional anaesthesia using lignocaine hydrochloride with or without modified standing stun on serum cortisol and behavioural changes during therapeutic hoof trimming. Twelve animals presented with sole lesion confined to a single hind limb claw were selected for the study. The animals were divided into two groups, Group I and Group II with six each. In Group I, animals were administered with IVRA using 10 mL of lignocaine hydrochloride (two per cent) injection in the digital vein of the affected limb after application of tourniquet in the metatarsal region. In Group II, along with IVRA, modified standing stun using butorphanol tartrate (0.01 mg/kg), xylazine hydrochloride (0.01 mg/kg) and ketamine hydrochloride (0.04 mg/kg) were administered intramuscularly. Serum cortisol level was estimated before anaesthetic procedure, during the procedure and four hours after therapeutic hoof trimming. Behavioural changes during therapeutic trimming were recorded. Following therapeutic hoof trimming, wooden blocks were applied and bandaged with 10 per cent zinc oxide ointment. In conclusion, serum cortisol level significantly decreased in Group II compared to Group I during trimming. Avoidance behaviour like withdrawal, head shaking, body jerking, and vocalisation significantly decreased in Group II compared to Group I. Serum cortisol level positively correlated with avoidance behaviours during therapeutic hoof trimming.

Keywords: *Sole lesion, avoidance behaviours, IVRA modified standing stun and cattle*

Lameness in dairy cattle is a serious welfare and economic problem. Claw disorders are responsible for 90% of lameness in dairy cattle (Shearer et al., 2013). Laminitis related lesions such as sole ulcers, white line disease and toe ulcer are major causes of chronic pain in cattle (Abhiram et al., 2023). In addition to production deficits, pain and distress associated with lameness represent a negative animal welfare issue (Philip and Martin, 2023). Hence early diagnosis and therapeutic hoof trimming are essential in bringing back the animal to its optimum production (Philip et al., 2022). One of

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the important steps in therapeutic hoof trimming protocol is pain management. Intravenous regional anaesthesia (IVRA) using lignocaine have been reported for distal limb surgery and therapeutic hoof trimming (Kumar et al., 2020). However, IVRA alone may not adequately control stress or pain-related behavioural responses (Rizk et al., 2012). Therefore, a multimodal analgesia is required to achieve effective pain control, minimise stress, and improve animal welfare during therapeutic hoof trimming (Coetzee et al., 2010). Standing stun using butorphanol tartrate, xylazine hydrochloride and ketamine hydrochloride is reported for large animal surgery (Kelly, 2018) but has a disadvantage of recumbency during hoof trimming. To minimize this risk, a modified standing stun protocol with a reduced dose of xylazine hydrochloride has been advocated. Hence this study was carried out to compare the effect of intravenous regional anaesthesia (IVRA) using lignocaine with and without modified standing stun on serum cortisol and behavioural changes during therapeutic hoof trimming in dairy cattle.

Materials and methods

Twelve animals diagnosed with sole lesion confined to a single hind limb claw were selected for the study after screening of 30 clinically lame animals from University Livestock Farm and Fodder Research and Development Scheme, Mannuthy. The selected animals were randomly divided into two groups, Group I and Group II with six each. In Group I, 10 mL of 2% lignocaine hydrochloride was administered as IVRA, after applying tourniquet at mid metatarsal region on the affected limb. In Group II, a modified standing stun using injection of butorphanol tartrate 0.01 mg/kg, Xylazine hydrochloride @ 0.01 mg/kg and Ketamine hydrochloride @ 0.04 mg/kg were administered intramuscularly in a single bolus.. When the animal attained adequate sedation, 10 mL of 2% lignocaine hydrochloride injection was administered as IVRA after applying tourniquet at mid metatarsal region on the affected limb. Therapeutic hoof trimming along with hoof bandaging was done in all the animals. The serum cortisol level analysed using chemiluminescence immunoassay analyser, estimated before, during and four hours after hoof trimming. Frequency of avoidance behaviours like head shaking, body jerking, withdrawal, vocalisation and rearing during therapeutic hoof trimming were recorded and data were statistically analysed.

Results and discussion

Among the 12 clinically lame animals, sole ulcer (Fig 1.) accounted for 58.33 per cent of cases, followed by white line disease (Fig 2.) at 25 per cent and toe abscess at 16.67 per cent. Therapeutic hoof trimming was adopted as the treatment of choice for sole lesions and IVRA was employed in Group I animals for pain management. Intravenous regional analgesia was a simple and effective technique for achieving distal limb analgesia in cattle (Clarke and Trim, 2013). In Group II animals, a modified standing stun protocol consisting of an intramuscular bolus injection of 0.01 mg/kg xylazine hydrochloride, 0.01 mg/kg butorphanol tartrate, and 0.04 mg/kg ketamine hydrochloride was employed. Philip (2022) demonstrated that lowering the xylazine dose effectively reduced the incidence of recumbency while maintaining adequate sedation and analgesia.

Serum cortisol

Serum cortisol concentration is extensively used as a physiological marker for assessing stress in animals (Squires, 2024). Cortisol secretion is an integral component of the stress response, facilitating a range of physiological adjustments that help animals adapt to and mitigate the effects of stressors (Silanikove, 2000). Jisha (2020) reported a normal mean cortisol concentration of 33.88 nmol/L in cattle from a place Thrissur, Kerala State during the period from December to February, suggestive of the influence of local climate and management practices on cortisol secretion.

The mean serum cortisol concentrations recorded before therapeutic hoof trimming in Group I and Group II animals were 99.04 ± 27.90 and 74.22 ± 4.71 nmol/L respectively and were higher than basal values,

Fig 1. White line disease

Fig 2. Sole ulcer

Table 1 Serum cortisol of selected animals (n=12)

Variable		Before trimming	During trimming	After trimming	p value
Serum cortisol	**Group I**	99.04 ± 27.90^{A}	139.36 ± 26.23^{A}	42.12 ± 22.06^{A}	p=0.95
	Group II	74.22 ± 4.71^{A}	55.31 ± 6.68^{B}	22.30 ± 3.53^{A}	
	p<0.01				

***Significant at 0.01 level (p<0.01); Means having different letter as superscript differ significantly within column*

reflecting the presence of chronic pain associated with sole lesions. During therapeutic hoof trimming, serum cortisol concentration increased in Group I to 139.36 ± 26.23 nmol/L indicating a stress response in the absence of effective analgesia. In contrast, Group II animals showed a reduction in cortisol levels to 55.31 ± 6.68 nmol/L during trimming, suggesting adequate pain control and stress mitigation. Four hours after trimming, cortisol levels in Group I decreased markedly to 42.12 ± 22.06 nmol/L but remained above baseline, whereas Group II animals exhibited a further significant decline to 22.30 ± 3.53 nmol/L, approaching basal concentrations. Although no significant difference was observed between treatments, serum cortisol levels showed a significant ($p < 0.01$) increase in Group I and a significant decrease in Group II during therapeutic hoof trimming within group during the period of observation (Fig 3.).

The comparatively lower cortisol response in Group II indicated that modified standing sedation effectively attenuated the stress response associated with therapeutic hoof trimming. This is consistent with previous studies in cattle, where the combination of xylazine hydrochloride, ketamine hydrochloride, and butorphanol tartrate (XKB) reduced cortisol release during castration and dehorning (Baldridge *et al.,* 2011; Coetzee *et al.,* 2010), likely due to the analgesic and sedative effects of the drugs.

Behavioural changes during therapeutic trimming

Avoidance behaviour was elicited, when the animals were in stress or pain which include withdrawal, head shaking, body jerks, vocalisation and rearing (Górecka-Bruzda et al., 2025). In the present study, Group I animals showed higher frequency of avoidance behaviours indicating a greater degree of discomfort during the procedure. In contrast, Group II animals demonstrated markedly lower frequency for all avoidance behaviours, and the difference between the two groups were statistically significant. The comparatively reduced avoidance behaviour observed in Group II suggested improved analgesia and better animal compliance during therapeutic hoof trimming.

Similar findings were described by Górecka-Bruzda et al. (2017) that frequency of avoidance behaviours were higher during trimming in horse. Fekry et al. (2019) observed that lignocaine used alone resulted in higher levels of struggling and vocalisation, whereas the addition of sedative and analgesic agents such as romifidine and butorphanol significantly reduced these behaviours, with the greatest reduction seen when both agents were combined. Similarly, Rizk et al. (2012) reported that cows receiving xylazine in addition to IVRA exhibited fewer pain-related behaviours during claw treatment compared to animals receiving IVRA alone.

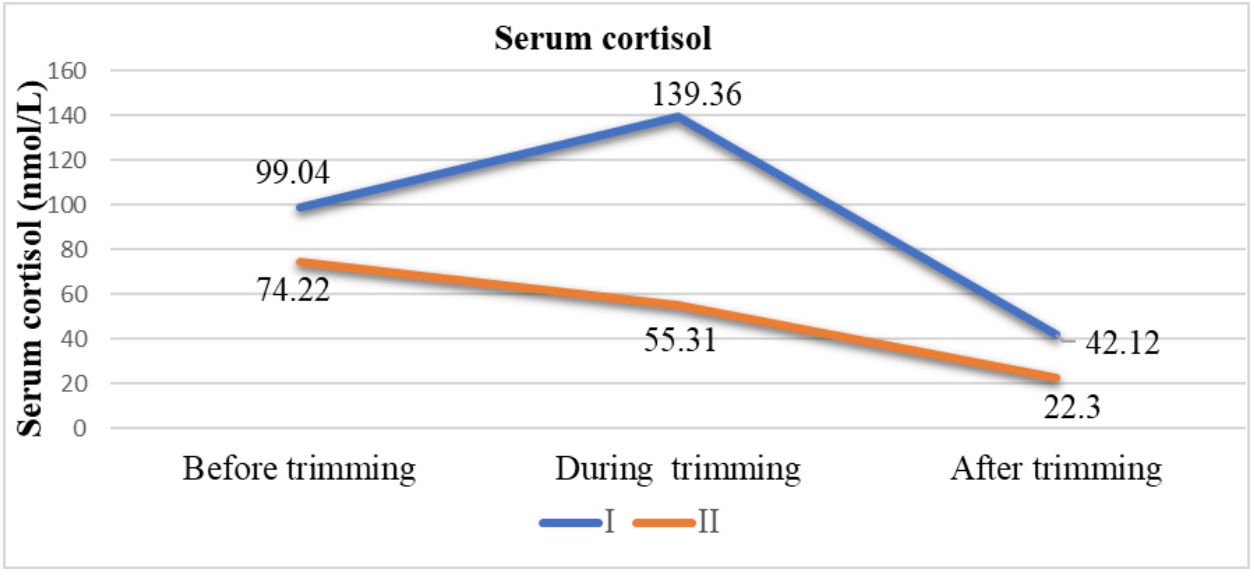

Fig 3. Graph indicating changes in serum cortisol

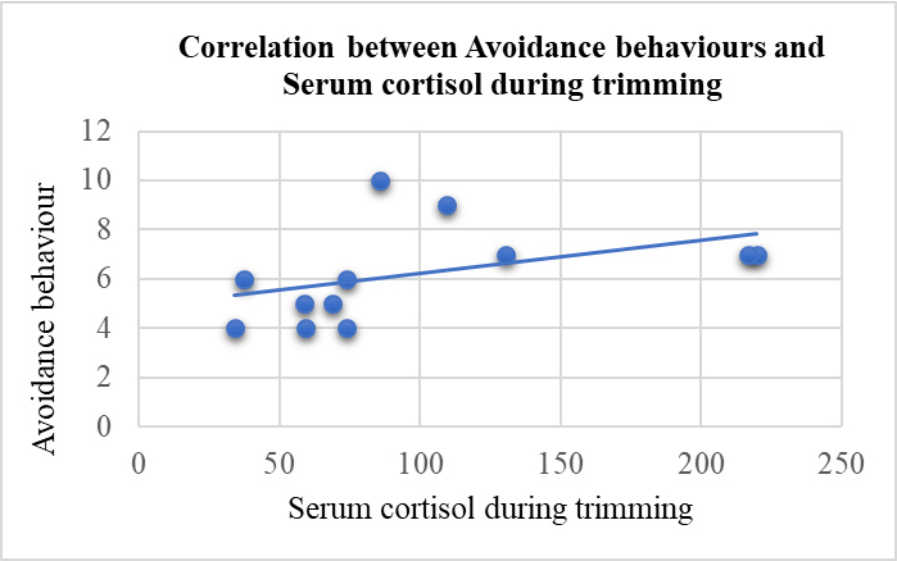

Fig 4. Graph indicating correlation between serum cortisol during trimming with avoidance behaviour

Table 2. Avoidance behaviour of selected animals (n=12)

Avoidance behaviour	Group I	Group II	p value
Withdrawal	$7.67^{a} \pm 0.49$	$2.167^{b} \pm 0.60$	0.009^{**}
Head shaking	$4.5^{a} \pm 0.56$	$0.5^{b} \pm 0.34$	0.004^{**}
Body jerks	$3.67^{a} \pm 0.33$	$0.67^{b} \pm 0.21$	0.009^{**}
Vocalisation	$2.67^{a} \pm 0.42$	$0.5^{b} \pm 0.22$	0.026^{*}
Rearing	$0.33^{a} \pm 0.21$	$0^{a} \pm 0$	0.394

**Significant at 0.05 level (p<0.05); **Significant at 0.01 level (p<0.01); Means having different letter as superscript differ significantly within a row*

The correlation of serum cortisol levels during therapeutic hoof trimming with frequency of avoidance behaviour was assessed by Spearman's rank correlation. Spearman's rank correlation analysis showed significant positive correlations (Fig 4.) for withdrawal (r = 0.712, p = 0.009), head shaking (r = 0.699, p = 0.011), body jerking (r = 0.792, p = 0.002), and vocalisation (r = 0.628, p = 0.029), whereas rearing exhibited a weaker and statistically non-significant correlation (r = 0.518, p = 0.084). Górecka-Bruzda et al. (2017) reported that avoidance behaviour during trimming in horse was positively correlated with cortisol.

Table 3. Correlation of serum cortisol during therapeutic hoof trimming on behavioural changes

Sl. No	Avoidance behaviour	Spearman's rank correlation coefficient (r)	p value
1	Withdrawal	0.712^{*}	0.009
2	Head shaking	0.699^{*}	0.011
3	Body jerking	0.792^{*}	0.002
4	Vocalisation	0.628*	0.029
5	Rearing	0.518	0.084

**Correlation is significant at 0.05 level, p=0.008(<0.05), r >0.3; weak correlation, 0.3 ≥ r ≤ 0.6; moderate correlation r> 0.6; strong correlation*

Conclusion

During therapeutic hoof trimming, animals subjected to modified standing stun with intravenous regional anaesthesia (IVRA) showed a significant decrease in serum cortisol concentration along with a significant reduction in avoidance behaviours such as withdrawal, head shaking, body jerking, and vocalisation, whereas animals receiving IVRA alone exhibited a significant increase in serum cortisol and avoidance behaviour during the procedure. Serum cortisol positively correlated with avoidance behaviour during therapeutic hoof trimming. IVRA combined with modified standing stun reduced stress, and avoidance behaviour compared to IVRA alone, hence recommended for therapeutic hoof trimming.

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Conflict of interest

The authors declare that they have no conflict of interest.

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