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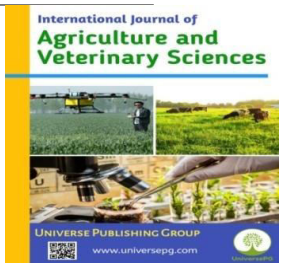


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# Comparison of High and Low Caudal Epidural Anesthesia by Use of Lidocaine Alone and Lidocaine-Xylazine Combination in Crossbred Cows of Khost, Afghanistan

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## Abstract

The use of caudal epidural anesthesia in cattle is indeed common in veterinary practice for various purposes such as reproductive manipulations, obstetrical and surgical procedures, and controlling rectal tenesmus. This study aims to compare the onset and duration of high and low caudal epidural anesthesia produced by lidocaine alone and lidocaine-xylazine combination in cows. Furthermore, this study determined the side effect of mentioned drugs on physiological parameters. In the present study totally 24 non-pregnant, crossbred cows were selected, and divided into two groups, sample size for each group was (n=12). Then each group were divided into two subgroups (12/2=6), each cow received only one group drug. The onset of high caudal epidural anesthesia for lidocaine-xylazine and lidocaine were 13.66±2.82, and 3.55±1.24, respectively. Also the onset time of low caudal epidural anesthesia for lidocaine-xylazine and lidocaine were 16.05±4.05 and 4.00±1.57, respectively. The duration time of high caudal epidural anesthesia for lidocaine-xylazine and lidocaine were 150.78±26.41and 66.33±10.71, respectively. Also the duration time of low caudal epidural anesthesia for lidocaine-xylazine and lidocaine were 120.28±36.08 and 55.77±20.28, respectively. Based on the statistical analysis, it was found that the onset and duration time of high and low caudal epidural anesthesia ware significantly prolonged ($P<0.05$) in lidocaine-xylazine, combination compared to the lidocaine alone. The heart rate, respiratory rate and rectal temperature of high and low caudal epidural anesthesia was significantly lower at ($P < 0.05$) in lidocaine-xylazine compared with lidocaine. In general, the lidocaine-xylazine had the longest onset time and duration of action for caudal epidural anesthesia, as well as lower heart rate, respiratory rate, and rectal temperature compared with the lidocaine alone.

**Keywords:** Afghanistan, Crossbred cows, Epidural anesthesia, Veterinary practice, Lidocaine, and Xylazine.

## 1. Introduction

The use of caudal epidural anesthesia in cattle is indeed common in veterinary practice for various purposes such as reproductive manipulations, obstetrical and surgical procedures, and controlling rectal tenesmus (Skarda and Tranquilli, 2007). Regional anesthesia is often preferred over general anesthesia in ruminants. This is because ruminants have certain anatomical and physiological peculiarities that can make general anesthesia more

challenging and risky. The use of local anesthesia in ruminants includes paravertebral nerve blocks, local administration, epidural anesthesia, and intravenous regional anesthesia of a distal limb (Skarda and Tranquilli, 2007). Epidural anesthesia techniques involve the use of dorsolumbar segment epidural blocks and low-posterior or caudal epidural blocks. The caudal epidural blocks are often used in surgeries to repair anal and perineal cleft lacerations, or uterine and rectal prolapse. They are also utilized to alleviate difficulties during delivery or ovum collection, as well as to restore control of urination and defecation (Sato *et al,* 2019).

Caudal epidural anesthesia is an easy and cost-effective technique for providing analgesia in cattle. It involves injecting anesthetic into the caudal epidural space, which is located in the sacrococcygeal space (S5-Co1) or first coccygeal space (Co1-Co2). A high caudal epidural at the sacrococcygeal space (S5-Co1) targets the sacral nerves S2, S3, S4, and S5. On the other hand, a low caudal epidural at the first coccygeal space (Co1-Co2) primarily affects the sacral nerves S3, S4, and S5. With an increase in the anesthetic dose, it is possible for nerves cranial to S2 to also become affected (Noordsy and Ames, 2006).

Xylazine is indeed an alpha2-adrenergic agonist commonly used in veterinary medicine for its sedative, analgesic, and muscle relaxant properties. It works by activating alpha2 receptors in the central and peripheral nervous systems, leading to sedation and analgesia. Epidural administration of xylazine has been found to be safe and effective for providing analgesia in horses compared to lidocaine, xylazine has shown less suppression of motor function. Lidocaine provides relatively short duration of anesthesia (Dehghani and Bigham, 2009). The short duration of anesthesia may not be sufficient for certain obstetric manipulations and surgical procedures involving the tail, perineum, anus, rectum, vulva, and vagina. As a result, a second dose of epidural lidocaine might be required, which could increase the risk of ataxia or even recumbency (Skarda & Tranquilli, 2007).

To our knowledge, literature on the use of lidocaine for perineal anesthesia in cows through high and low caudal epidural block is limited. However, there is no information available on the compression of the time onset and duration between high and low caudal epidural anesthesia in tail, perineum and upper hind limb areas of cows that was produced by lidocaine, and lidocaine–xylazine combinations. Also there is no information available for tail, and upper hind limb anesthesia in cows through high and low caudal epidural block that was produced by mentioned drugs. Beside that there is limited information available on the anesthetic efficacy of mentioned combinations on physiological parameters when using the high and low caudal epidural anesthetic technique in cows. By conducting this investigation, the literature was provided on the compression of the time onset and duration between high and low caudal epidural anesthesia in tail, perineum and upper hind limb areas of cows by use lidocaine, and lidocaine–xylazine combination. Also this study provided valuable information into the impact of lidocaine alone, and lidocaine–xylazine combination on physiological parameters that was used through high and low caudal epidural.

## 2. Material and Methods

### Study Area and Period

This study was conducted during a period of six months (June – Nov of 2023) in animal market at Matun of Khost province, Afghanistan.

### Drugs

Wilocaine (Manufacture by PLIVA PAKISTAN), and Xylax (Manufacture by MYLAB PAKISTAN) used in this study which purchased from Kabul market. Manufacture and expire date were cheeked and saved in valid condition base on the drugs package inserts. Both the drugs were tested for quality in Medicine, Healthcare Products and Food Quality Control Laboratory, Kabul, Afghanistan.

### Type and Design of study

This was an experimental study (Vesal *et al.,* 2013). During this study a total of 24 females, non-pregnant, crossbred cows regardless of age with average Body Weight (BW) of 295.1±51.39 kg were selected. The mentioned cows were fed equally with natural grass, forages and concentrates. Drinking water was provided ad libitum. Firstly, the examination of reproductive system was done. The cows were divided into the two groups (High caudal epidural block and low caudal epidural block) (24/2=12). Then each group were divided into two subgroups (Control and treatment) (12/2=6). So that

each subgroups consisting of six animals and received one of the following treatments:

High and low caudal epidural control groups: 0.22 mg/kg of 2% lidocaine (Ismail, 2016).

High and low caudal epidural treatment groups: 0.22 mg/kg of 2% lidocaine in combination with 0.05 mg/kg of 10% xylazine (Dehghani and Bigham, 2009) (**Table 1**).

**Table 1:** The characteristics of both drugs and experimental cows.

| Groups | Subgroups | Animals | Dosage | |
|---|---|---|---|---|
| | | | Lidocaine (mg/kg) | Lidocaine-xylazine (mg/kg) |
| High caudal epidural (HCE) | Control | 6 | 0.22 | - |
| | Treatment | 6 | 0.22 | 0.05 |
| Low caudal epidural (LCE) | Control | 6 | 0.22 | - |
| | Treatment | 6 | 0.22 | 0.05 |

**Procedure**

The cow was restrained in a standing position for administering one of the anesthetic agents through high and low caudal epidural technique. The chest girth circumference was measured in centimeters and compared it to the measurements of table. Body weight was determined using girth circumference described by (Finley, 2013). Heart Rate, Respiratory Rate and Rectal Temperature were evaluated pretreatment and at predetermined intervals during and post treatment. Both single drug and a mixture drug were freshly prepared immediately before use base on every body weight and each cow received only the treatment of one group. Hair in the sacrococcygeal area was clipped and the skin were scrubbed and disinfected. The tail moved up and down to locate the fascia between the Sacral 5 and coccygeal 1 vertebra and coccygeal 1 and coccygeal 2 vertebras (Edmondson, 2008). An 18-gauge 3.8-cm needle (with no syringe attached) was directed perpendicular to the skin surface (Skarda, 1996). Once the skin is penetrated, place a drop of local anesthetic solution in the hub of the needle (using the hanging drop technique). The needle should then be advanced slowly until the anesthetic solution is drawn into the epidural space by negative pressure (Edmondson, 2008). The syringe may then be attached to the needle and the anesthetic solution slowly injected.

**Data collection**

**Onset of action**

In this study record the cow's response at one-minute intervals after the pinpricks, with a 25-gauge needle, were made on tail, perineum and upper hind limb areas. A strong avoidance response was observed, which included actions like kicking, rapid shifting of weight on the hind limbs, rapid movement of the tail, and turning of the head towards the site of the pinpricks. The time, at which a diminished avoidance response was observed, the reactions were recorded as the time of onset of action.

**Duration of action**

The duration of anesthesia in this study was defined as the interval from the onset of anesthesia to the full return of sensation at the site. The cases were observed continuously in every 5 minutes' interval, until they had a normal response to the stimulus.

**Physiological parameters**

- Heart rate (Beats/ minute): Auscultation is a method used to measure the heart rate by listening to the heart sounds using a stethoscope. In this case, the heart rate was measured at different time points: 0, 15, 30, 45, 60, 75 and 90 minutes' post treatment.
- Respiratory rate (Breaths/ minute): By observing the movement of the thoracic and abdominal wall during inspiration and expiration, it is possible to assess the respiratory rate at different time points such as 0, 15, 30, 45, 60, 75 and 90 minutes' post treatment.
- Rectal temperature ($^0$C): By the placing of clinical thermometer into the rectum of animals, the rectal temperature was recorded at 0, 15, 30, 45, 60, 75 and 90 minutes' post treatment.

**Statistical analyses**

Data analyses were performed using SPSS software version 16. The comparison of onset and duration of control and treatment groups' anti-nociception in tail, perineal and upper hind limb area was done using one-way analysis of variance (ANOVA-SPSS) according to the method described by Snedecor and Cochran (1967). Independent-Samples-T Test was performed to the determine

differences between S5-C1 and C1-C2 roots of Control and treatment groups. Paired-Samples T Test was used for comparison of means within the group from 0 hour and between the group Control and treatment at different intervals of anesthetic study. All data are presented as mean values ± standard deviation and a value at $p < 0.05$ was considered significant.

## 3. Results

In the present study, loss and return of sensation to pin-pricking were observed in the tail, perineal and upper hind limb areas following high and low caudal epidural administration of lidocaine alone, and lidocaine-xylazine combinations. The results of the study are presented as follows.

### Onset of action (minutes)

At the tail area the mean ± SD values of onset time for lidocaine-xylazine and lidocaine were 12.00± 1.78 minutes, and 2.16±0.40 minutes, respectively, following administration through the high caudal epidural route. Similarly, at the tail area, the mean ± SD values of onset time for lidocaine-xylazine and lidocaine were 12.00±1.78 minutes, and 2.16±0.40 minutes, respectively, following administration through the low caudal epidural route. Based on the statistical analysis, the onset time in the tail area through the both routes were significantly prolonged (P<0.05) with lidocaine-xylazine compared to the lidocaine. However, the difference in the onset time between high and low caudal epidural routes at the tail area was not significant (P > 0.05) within each group (**Table 2**).

At the perineum area the mean ± SD values of onset time for lidocaine-xylazine and lidocaine following high caudal epidural administration were 13.66± 2.58 minutes and 3.66±0.81 minutes, respectively. Similarly, after low caudal epidural administration, the onset time in perineal area were 16.16±2.63 minutes for lidocaine-xylazine and 3.83±0.98 minutes for lidocaine. Statistical analysis showed that, in the perineal area, both administration routes resulted in a significantly longer onset time (P<0.05) with lidocaine-xylazine compared to the lidocaine.

However, the difference in onset time between high and low caudal epidural routes at the perineum area was not significant (P > 0.05) within each group (**Table 2**).

In the upper hind limb area, the results showed that the onset time for lidocaine-xylazine and lidocaine were 15.33±3.26 minutes, and 4.83±0.40 minutes, respectively, following administration via the high caudal epidural route. Similarly, the results showed that the onset time in the upper hind limb area for lidocaine-xylazine and lidocaine were 19.66±2.94 minutes, and 5.33±1.50 minutes, respectively, after administration via the low caudal epidural route. In both administration routes, lidocaine-xylazine produced a significantly longer onset time (P<0.05) compared to lidocaine. However, the difference in the onset times between high and low caudal epidural routes within each groups was not significant (P>0.05) (**Table 2**).

### Duration of action (minutes)

At the tail area the mean ± SD duration time for lidocaine-xylazine and lidocaine were 168.83±20.52 minutes and 74.50±3.72 minutes, respectively, following administration via the high caudal epidural route. Likewise, at the tail area, the mean ± SD duration time for lidocaine-xylazine and lidocaine were 146.33±28.21 minutes, and 72.16± 11.19 minutes, respectively, after administration through the low caudal epidural route. Statistical analysis showed that, in the tail area, both routes produced a significantly longer duration (P<0.05) with lidocaine-xylazine compared to the lidocaine alone. However, the difference in duration time between high and low caudal epidural routes within each group was not significant (P > 0.05) (**Table 3**). At the perineal area, the mean ± SD duration time for lidocaine-xylazine and lidocaine following high caudal epidural administration were 156.67±20.93 minutes and 68.00±3.94 minutes, respectively. Similarly, after low caudal epidural administration, the duration time in perineal area were 127.67± 24.11 minutes for lidocaine-xylazine and 63.00± 12.69 minutes for lidocaine. Statistical analysis indicated that, in the perineal area, both administration routes produced a significantly longer duration (P<0.05) with lidocaine-xylazine compared to the lidocaine. However, the difference in duration time between high and low caudal epidural routes within each group was not significant (P > 0.05) (**Table 3**).

In the upper hind limb area, the results showed that the duration time for lidocaine-xylazine and lidocaine was 126.83±19.81 minutes and 56.50±

12.70 minutes, respectively, following administration through the high caudal epidural route. Likewise, after administration through the low caudal epidural route, the duration time in the upper hind limb area were 86.83±28.77 minutes for lidocaine-xylazine and 32.16±7.67 minutes for lidocaine. In both administration routes, lidocaine-xylazine produced a significantly longer duration (P<0.05) compared to lidocaine alone. However, the difference in duration times between high and low caudal epidural routes within each groups was not significant (P>0.05) (**Table 3**).

**Physiological parameters**

**Heart rate (beats/ min)**

The study revealed statistically significant differences in heart rate within the lidocaine-xylazine group at various time intervals (P<0.05), following administration through the high caudal epidural route. Specifically, the lidocaine-xylazine group exhibited a significantly lower heart rate compared to the lidocaine group (P<0.05) after high caudal epidural administration.

Similarly, within the lidocaine-xylazine group, heart rate differences were also statistically significant (P<0.05) after administration through the low caudal epidural route. In this route as well, the heart rate was significantly lower (P<0.05) in the lidocaine-xylazine group compared to the lidocaine group, following administration through the low caudal epidural route. However, the difference in heart rate between high and low caudal epidural routes was not significant (P>0.05) within each group (**Table 4**).

**Respiratory rate (breaths/ min)**

The study found statistically significant differences (P<0.05) in respiratory rates within the lidocaine-xylazine group at different time intervals following high caudal epidural administration. Specifically, the respiratory rate in the lidocaine-xylazine group was significantly lower (P<0.05) compared to the lidocaine group after high caudal epidural administration. Similarly, when comparing respiratory rates within the lidocaine-xylazine group at different intervals after low caudal epidural administration, a statistically significant difference (P<0.05) was observed. The lidocaine-xylazine group again exhibited a significantly lower respiratory rates of (P<0.05) compared to the lidocaine group following low caudal epidural administration. However, the difference in the respiratory rate between the high and low caudal epidural routes within each group was not significant (P>0.05) (**Table 5**).

**Rectal Temperature (0C)**

The comparison within the lidocaine-xylazine group at different intervals showed statistically significant differences (P<0.05) in the rectal temperature following administration via the high caudal epidural route. Specifically, the rectal temperature in the lidocaine-xylazine group was significantly lower (P<0.05) compared to the lidocaine group after high caudal epidural administration. Similarly, when RT was compared within the lidocaine-xylazine group at different intervals after low caudal epidural administration, a statistically significant difference (P<0.05) was observed. In this as well, the lidocaine-xylazine group showed significantly lower RT (P<0.05) compared to the lidocaine group. However, the difference in RT between high and low caudal epidural routes within each group was not significant (P > 0.05) (**Table 6**).

**Table 2:** Mean ± SD of onset time of anesthesia after high and low caudal epidural administration of lidocaine, and lidocaine–xylazine in three different areas (N=24).

| Indices | Nerve roots | Control Group | Treatment Group |
|---|---|---|---|
| | | LID | LID-XYL |
| OTA (min) | $S_5$-$C_1$ | 2.16±0.40 | 12.00±1.78 *** |
| | $C_1$-$C_2$ | 2.83±1.16 | 12.33±2.80 *** |
| OPA (min) | $S_5$-$C_1$ | 3.66±0.81 | 13.66±2.58 *** |
| | $C_1$-$C_2$ | 3.83±1.98 | 16.16±2.63 *** |
| OUHLA (min) | $S_5$-$C_1$ | 4.83±0.40 | 15.33±3.26 *** |
| | $C_1$-$C_2$ | 5.33±1.50 | 19.66±2.94 *** |

*Statistically significant difference between onset of treatment group with control group (p<0.05). OTA = Onset of Tail Anesthesia, OPA = Onset of Perineal Anesthesia and OUHLA = Onset of Upper Hind Limb Anesthesia. Note: * = 0.03-0.05, ** = 0.01-0.03 and *** = > 0.01.

**Table 3:** Mean ± SD of duration time of anesthesia after high and low caudal epidural administration of lidocaine, and lidocaine–xylazine in three different areas (N=24).

| Indices | Nerve roots | Control Group | Treatment Group |
|---|---|---|---|
| | | LID | LID-XYL |
| DTA (min) | $S_5$-$C_1$ | 74.50±3.72 | 168.83±20.52 *** |
| | $C_1$-$C_2$ | 72.16±11.19 | 146.33±28.21 *** |
| DPA (min) | $S_5$-$C_1$ | 68.00±3.94 | 156.67±20.93 *** |
| | $C_1$-$C_2$ | 63.00±12.69 | 127.67±24.11 *** |
| DUHLA (min) | $S_5$-$C_1$ | 56.50±12.70 | 126.83±19.81 *** |
| | $C_1$-$C_2$ | 32.16±7.67 | 86.83±28.77 *** |

*Statistically significant difference between duration of treatment group with control group ($p<0.05$).
DTA = Duration of Tail Anesthesia, DPA = Duration of Perineal Anesthesia and DUHLA = Duration of Upper Hind Limb Anesthesia. Note: * = 0.03-0.05, ** = 0.01-0.03 and *** = > 0.01.

**Table 4:** Mean ± SD of heart rates (beats/min) under high and low caudal epidural anesthesia with lidocaine, and lidocaine–xylazine (N=24).

| Indices | | Heart rate (beats/ min) | | | |
|---|---|---|---|---|---|
| Drugs | | Lidocaine | | Lidocaine-xylazine [a] | |
| Roots of Administration | | S5-C1 | C1-C2 | S5-C1 | C1-C2 |
| Time interval (min) | 0 | 64.00±5.05 | 68.66±5.88 | 71.33±8.91 | 64.00±5.65 |
| | 15 | 63.66±4.08 | 66.66±5.46 | 62.00±4.19 | 55.50±4.54 |
| | 30 | 62.66±4.13 | 64.66±4.67 | 57.66±8.04* | 51.50±4.54 |
| | 45 | 62.66±5.00 | 64.00±4.38 | 53.66±5.98* | 49.50±5.43 |
| | 60 | 61.33±4.84 | 62.66±4.13 | 50.66±4.13 | 45.50±5.43 |
| | 75 | 60.33±3.66 | 65.33±6.02 | 50.66±6.53** | 49.50±3.20** |
| | 90 | 60.33±4.45 | 63.33±3.01 | 55.66±7.20* | 54.66±5.46 |

*Statistically significant difference between Heart rate of different times with Baseline time ($p<0.05$). [a] Statistically significant difference between Heart rate of lidocaine-xylazine with lidocaine groups ($p<0.05$). Note: * = 0.03-0.05, ** = 0.01-0.03 and *** = > 0.01.

**Table 6:** Mean ± SD of rectal temperature (°C) under high and low caudal epidural anesthesia with lidocaine, and lidocaine–xylazine (N=24).

| Indices | | Rectal temperature (°C) | | | |
|---|---|---|---|---|---|
| Drugs | | Lidocaine | | Lidocaine-xylazine [a] | |
| Roots of Administration | | $S_5$-$C_1$ | $C_1$-$C_2$ | $S_5$-$C_1$ [a] | $C_1$-$C_2$ [a] |
| Time interval (min) | 0 | 38.63±0.42 | 38.30±0.27 | 38.35±0.30 | 38.53±0.08 |
| | 15 | 38.55±0.36** | 38.50±0.18 | 38.35±0.30* | 38.48±0.13 |
| | 30 | 38.50±0.36** | 38.45±0.18* | 38.38±0.40 | 38.33±0.17 |
| | 45 | 38.66±0.29 | 38.31±0.33 | 38.25±0.38 | 38.23±0.10 |
| | 60 | 38.70±0.25 | 38.15±0.45 | 38.08±0.54 | 38.18±0.07* |
| | 75 | 38.75±0.25 | 38.06±0.66 | 38.05±0.61 | 38.10±0.17* |
| | 90 | 38.66±0.32 | 38.40±0.29* | 38.11±0.54 | 38.10±0.16* |

*Statistically significant difference between Rectal temperature of different times with Baseline time ($p<0.05$). [a] Statistically significant difference between Rectal temperature of lidocaine-xylazine with lidocaine groups ($p<0.05$). Note: * = 0.03-0.05, ** = 0.01-0.03 and *** = > 0.01.

## 4. Discussion

Lidocaine is one of the most useful drugs for local and regional anesthesia in different animals. In this study, xylazine was used with lidocaine as combination to evaluate their onset and duration time of anesthesia and side effect on physiological parameters which were administrated by high and low caudal epidural space.

**Onset of action (minutes)**

The study compared the onset of caudal epidural anesthesia in horses using lidocaine alone versus a combination of xylazine and lidocaine. Their findings showed no significant difference in the time of onset between lidocaine (4.3+/-0.8 minutes) and the lidocaine-xylazine combination (5.3+/-1.3 minutes). On the other hand, the present study also investigated the onset of caudal epidural anesthesia by comparing the combination of lidocaine and xylazine with the lidocaine alone. The mean ± SD values of onset times for LID-XYL and LID groups were 13.66±2.58 and 3.66±0.81 minutes, respectively. Comparing the two studies reveals a clear discrepancy: while found no meaningful prolongation of onset with the addition of xylazine, the present study demonstrates a significant extension in onset time for the lidocaine–xylazine combination. This difference suggests that factors such as methodological variations, drug dosages, or horse-related variables may account for the contrasting outcomes.

When comparing the results of the studies conducted by (Grubb *et al.,* 2002; Shokry and Elkasapy, 2018) and the present study regarding the onset time of anesthesia, noticeable variations are observed between lidocaine-xylazine combinations and lidocaine alone. The present study, which focused on the onset of high caudal epidural anesthesia in cattle, reported the mean onset time of 13.66±2.58 minutes for the lidocaine-xylazine group and 3.66±0.81 minutes for lidocaine group. In contrast, Grubb *et al.* (2002) found a mean onset time of 4.8 ± 1.0 minutes for lidocaine alone and 5.1 ± 0.9 minutes for the lidocaine-xylazine combination. Similarly, the study by Shokry and Elkasapy, (2018) in Egyptian water buffalo reported onset times of 3.4 ± 0.9 minutes for lidocaine and 6.4 ± 1.1 minutes for the lidocaine-xylazine combination. Collectively, the results of the present study support previous findings indicating that combining lidocaine with xylazine in epidural anesthesia prolongs the onset of anesthesia. This combination has consistently demonstrated a longer onset time compared to using lidocaine alone.

The study conducted by Pagliosa *et al.* (2015) reported a mean onset time of 3.0±1.2 minutes for lidocaine which was administrated by low caudal epidural of bulls. On the other hand, the present study reported the mean ± SD values of 3.83±0.94 minutes for the onset of low caudal epidural anesthesia for the same lidocaine group in cows. The results of present study were approximately consisted with Pagliosa *et al* study.

**Duration of action (minutes)**

The study conducted by Molaei *et al.* (2010) aimed to investigate the anesthetic effects of lidocaine and a combination of lidocaine and xylazine in low caudal epidural anesthesia in dromedary camels. They found that Group lidocaine-xylazine (185.27± 12.24 minutes) had a significantly longer duration of complete perineal anesthesia compared to Group lidocaine (67.46±6.27 minutes). On the other hand, the present study focused on the duration of low caudal epidural anesthesia of cows in the perineum area. The mean duration values were reported as 127.67±24.11 minutes for the LID-XYL group and 63.00±12.69 minutes for the LID group. Comparing the results of present study with Molaei *et al.* (2010), it can be observed that both studies demonstrate a longer duration of anesthesia in the group that received the combination of lidocaine and xylazine (LID-XYL) compared to the group that received lidocaine only (LID).

The study conducted by Grubb *et al.* in 1992 compared the duration of perineal anesthesia in horses by administering lidocaine alone and a combination of lidocaine-xylazine in the caudal epidural space. They found that the duration of anesthesia was significantly longer for the lidocaine-xylazine combination (329.8±6.2 minutes) compared to lidocaine alone (87.2±7.5 minutes). On the other hand, present study investigated the duration of high caudal epidural anesthesia in the perineum area using lidocaine alone (LID) and lidocaine-xylazine combination (LID-XYL). The mean duration ± SD for LID-XYL was 156.67± 20.93 minutes, while for LID it was 68.00±3.94 minutes. Comparing these two studies, it is evident that both studies found a longer duration of anesthesia with the lidocaine-xylazine combination compared to lidocaine alone.

Rostami and Vesal, (2012) compared the anesthetic effects of lidocaine-xylazine combination in fat-tailed sheep. The mean duration of anesthesia for the LID group was 107.9 minutes, while it was 147.6 minutes for the LID-XYL group. Grubb *et al.* (2002)

focused on dairy cattle and compared the duration of anesthesia when lidocaine-xylazine combination (302.8±11.0 minutes) was administered versus lidocaine alone (81.8±11.8 minutes) in caudal epidural space. Shokry and Elkasapy, (2018) aimed to evaluate and compare the anesthetic effects of lidocaine-xylazine (145.8±3.3 minutes) versus lidocaine alone (118.4±2.7 minutes) for high epidural anesthesia in Egyptian water buffalo. The present investigation measured the duration of high caudal epidural anesthesia in LID-XYL (156.67± 20.93 minutes) and LID (68.00±3.94 minutes) groups. Overall, the findings from all these studies consistently suggest that the use of lidocaine-xylazine combinations generally results in a longer duration of anesthesia compared to lidocaine alone.

**Physiological parameters**

The study conducted by Molaei *et al.* (2010) investigated the analgesic effects of lidocaine and a combination of lidocaine and xylazine in low caudal epidural anesthesia in dromedary camels. The study observed significant changes in respiratory rate (RR), heart rate (HR), and rectal temperature (RT) in the lidocaine-xylazine group. In contrast, the lidocaine group did not show any significant changes in RR, HR, or RT compared to baseline values. On the other hand, the present study compared the heart rate, respiratory rate, and rectal temperature of low caudal epidural anesthesia in lidocaine and lidocaine-xylazine groups. The results indicated that the lidocaine-xylazine group exhibited significantly lower values for heart rate, respiratory rate, and rectal temperature compared to the lidocaine group ($P<0.05$). Comparing the results of present study with Molaei *et al.* (2010), both studies indicate that the combination of lidocaine and xylazine (LID-XYL) resulted in greater changes in the measured parameters (HR, RR, and RT). Overall, both studies suggest that the combination of lidocaine and xylazine has a more pronounced effect on HR, RR, and RT compared to lidocaine alone.

In the study conducted by Meyer *et al.* (2007), they found that after high caudal epidural anesthesia in calves with xylazine administration, both heart rate and respiratory rate decreased significantly at a significance level of $P<0.05$. On the other hand, the present study compared the effects of high caudal epidural anesthesia using lidocaine and lidocaine-xylazine in cows. The lidocaine-xylazine group had significantly lower heart rate, respiratory rate, and rectal temperature compared to the lidocaine group, with a significance level of $P<0.05$. Comparing the two studies, it seems that both studies show a decrease in heart rate and respiratory rate following epidural anesthesia with xylazine administration.

Further research and clinical trials are required to fully understand the optimum dose for particular obstetrical and surgical intervention of these combinations and to evaluate its benefits and potential drawbacks in different clinical settings, and to establish the safety and efficacy of these combinations in different contexts. It is important for veterinarians to consider these findings when determining the appropriate anesthesia protocol for perineal procedures in veterinary medicine.

## 5. Conclusion

Caudal epidural anesthesia is commonly used in veterinary medicine for diagnostic, obstrical and surgical interventions in perineal regions of cows. This study was performed to compare the onset and duration time of high and low caudal epidural anesthesia produced by the owner should understand the outcome of the disease. In conclusion, the LID group is likely to produce the quickest onset of anesthetic effect between high and low caudal epidural blocks. The LID-XYL group consistently showed significantly longer onset times compared to the LID group in the tail, perineum, and upper hind limb areas. On the other hand, the group of drugs that was have the longest duration of action between high and low caudal epidural block is the LID-XYL group. This group consistently had significantly prolonged durations of high and low caudal epidural anesthesia compared to the LID group in the tail, perineum, and upper hind limb areas. Regarding the side effects on physiological parameters in cows. The LID-XYL group consistently showed the lowest heart rate in both high and low caudal epidural anesthesia. In terms of respiratory rate, the LID-XYL group had significantly lower rates compared to the LID group in both high and low caudal epidural anesthesia. As for rectal temperature, the LID-XYL group consistently had significantly lower temperatures compared to the LID group during both high and low caudal epidural anesthesia. Therefore, based on the information provided, the LID-XYL group may have side effects on physiological parameters in cows, including lower

heart rate, lower respiratory rate, and lower rectal temperature. In general, the LID-XYL group had the longest onset and duration of action for epidural anesthesia, as well as lower heart rate, respiratory rate, and rectal temperature compared to the LID group.

## 6. Ethical Clearance

This research was conducted in accordance with ethical standards for animal research. Ethical approval was granted by the Ethics Committee of Shaikh Zayed University, and all experimental procedures complied with national and international guidelines for the human care and use of animals.

## 7. Author contributions

D.S.: Conceptualization, data collection, analysis, manuscript drafting, methodology design and correspondence. H.N.: Statistical analysis, data interpretation, manuscript review and manuscript editing. L.M.: Super vision, project administration, and critical revision of the manuscript. A.M.: Data collection assistance, fieldwork coordination, visualization, and literature review.

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## 9. Conflicts of Interest

The authors report no conflicts of interest related to this study.

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