

Full length research paper

Studies on Epidural anaesthesia using lidocaine with Adrenaline on Hemato-biochemical responses in pregnant West African Dwarf goats

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Epidural anesthesia is commonly utilized in veterinary medicine to allow diagnostic, obstetrical, and surgical interventions caudal to the umbilicus in the perineal region of large animal. Addition of a vasoconstrictor to a local anesthetic has been shown to have several beneficial effects. This study was carried out to investigate the effects of lidocaine with epinephrine on physiological, haematological and biochemical parameters in pregnant West African dwarf goats. Four healthy pregnant goats were administered with lidocaine combined with epinephrine (4µg/ml) in the lumbosacral epidural space. Physiological parameters were taken at 30minutes intervals while the hematological and biochemical analyses were done hourly for 3 hours. There were decreases in the hematological parameters including Hb, PCV, RBCs, Neutrophil and platelets after epidural analgesia especially at second and third hours post administration. The glucose, sodium ion, potassium ion, chloride ion, bicarbonate ion increased significantly ($P<0.05$) at the third hour post administration while the urea and creatinine levels did not show any significant change. The heart rate decreased significantly ($P<0.05$) post administration of drugs when compared with the onset, respiratory rate increased while the rectal temperature showed a non-significant change. In conclusion, the combination of epinephrine and lidocaine solution for epidural anaesthesia provided a prolonged duration of action without any serious adverse effects in pregnant goats.

Keywords: Lidocaine, epinephrine, epidural, pregnant, West African Dwarf Goat

Introduction

Anaesthesia is one of the miracles of medicine, without which modern surgical techniques would have been impossible. It was first developed to alleviate pain and provide relaxation for surgery. It is employed in animals for a wide variety of operative interventions. The choice of different types of anaesthesia, use of anaesthetic and analgesic agents, route of administration of anaesthetic agents all are depended on the animals as well as the surgical procedures (Roy *et al.*, 2015). Ruminants are generally not considered good subjects for general anaesthesia mainly because of the hazards of regurgitation and inhalation of ruminal contents or saliva into the lungs if the airway is left unprotected (Trim, 1981; Hall and Clark, 1991). Thus, regional anaesthesia produced by perineural or epidural injections of anaesthetic agents is most frequently employed in these

species. Epidural anesthesia is commonly utilized in veterinary medicine to allow diagnostic, obstetrical, and surgical interventions caudal to the umbilicus in the perineal region of large animal (Elmore, 1980; Skarda, 1996; Skarda and Tranquilli, 2007).

Lidocaine is the most frequently used local anaesthetic solution for epidural or subarachnoid anaesthesia in small ruminants, which causes a blockage of the sensory, sympathetic and motor fibres, producing hypotension and ataxia (Skarda and Tranquilli, 2007). Lidocaine is an amide type local analgesic and has a relatively rapid onset of action and an intermediate duration of about 1 to 2 hours (Carpenter *et al.*, 2004). The effects of epinephrine in local anesthetics have been well established. Epinephrine is the most commonly used constrictor of blood vessels and blood coagulation

accelerator, especially on the skin or mucous membranes for bleeding control at the procedure site (Folwaczny *et al.*, 1999; Koay and Orengo, 2002). It can reduce the absorption of local anesthetics into the bloodstream, resulting in decreased systemic toxic side effects, prolonged clinical duration of action and decreased surgical blood loss (Dunlevy *et al.*, 1996).

The concomitant administration of the vasoconstrictor epinephrine has been reported to improve the onset, duration, and intensity of the sensory and motor block and to decrease plasma concentrations of local anaesthetic responsible for systemic toxicity. These effects were reported with lidocaine, which is less lipophilic and less bound to plasma proteins than bupivacaine (Sakuru *et al.*, 1999; Sinnott *et al.*, 2003). To our knowledge, effects of epinephrine addition on the anaesthetic properties of lidocaine after epidural administration in pregnant goats have not been reported previously. Therefore, this study will give surgeons insight into the physiologic effects of epidural lidocaine with adrenaline on animal before and during the surgical procedures and ease of assessing clinical outcomes.

MATERIALS AND METHODS

Experimental animal/protocol

Four pregnant and healthy West African dwarf goats were used in this study. The lumbosacral area of each goat was aseptically prepared by shaving the coat, cleaning with disinfectant and finally with methylated spirit. We maintained all animals in sternal recumbency for identification of the lumbosacral epidural space. This space was identified by the depression between the last lumbar vertebra and the 1st sacral vertebra. Correct positioning of the needle was confirmed by the hanging-drop method and loss of resistance by injected air into the epidural space. 2ml (40mg) each of lignocaine HCl in combination with adrenaline {2% lidocaine with adrenaline USP (Labcalin®, Laborate Pharmaceutical India) was injected into the space using a 10ml syringe and 21gauge needle. The caudolateral aspect of the abdominal wall was pricked using a sterile 21 gauge hypodermic needle immediately the anaesthetic agent was injected to ascertain and note the time of onset and duration (i.e. immediately the anaesthetic agent waned).

Hematological and biochemical analyses

2.5ml of blood was collected by jugular venipuncture using a sterile needle and syringe both for analyses. Blood was collected at the onset of epidural administration and then hourly for 3 hours post administration. The blood samples collected for haematology were evaluated for packed cell volume

(PCV) using the haematocrit method (Jain and Schalm, 1986). Haemoglobin concentration was evaluated using the cyanomethaemoglobin method (Schalm *et al.*, 1975). Red blood cell count was determined by the haematocytometry method (Jain and Schalm, 1986). Total white blood cell (WBC) counts and differential leucocyte counts were estimated according to Coles (1989). Serum urea and Creatinine levels were determined using photoelectric colorimeter (Coles, 1989). The serum electrolyte levels were evaluated using flame photometry (Jones, 1995).

Vital signs analysis

Heart rate (HR) was measured by counting the heart beats over the cardiac area using a stethoscope. Respiratory rate (RR) was measured by counting chest movements per minute and rectal temperature (OC) was measured with a digital thermometer. HR, RR, and rectal temperature were recorded at onset and at 30-minute intervals for 3 hours after the administration of the drug.

Statistical analysis

Data collected were subjected to statistical analysis using ANOVA, followed by Turkey's multiple comparison. Values of $P < 0.05$ were considered statistical significant and were presented as Mean \pm standard error of mean.

Results

The Packed cell volume (PCV), Hemoglobin concentration (Hb), red blood cell count (RBC), white blood cell (WBC), Platelets and Neutrophil decreased significantly ($P < 0.05$) mostly at the third hour post anaesthesia compared with the onset values. The lymphocytes increased significantly ($P < 0.05$) at every hour post anaesthesia as compared with the onset value (Table 1). The Glucose, Sodium ion, Potassium ion, Chloride ion and Urea increased significantly ($P < 0.05$) at the third hour post anaesthesia as compared with the onset values. The bicarbonate and Creatinine showed a non-significant change across the post anaesthesia study hours (Table 2).

Discussion

Local anesthetics have the unique ability to block completely the sensation of pain and have been used clinically as adjuncts to light general anesthesia in both small and large animals (Skarda and Tranquilli, 2007). Vasoconstrictors (mainly epinephrine) were used to increase the depth or duration of local anesthetics for

Table 1: Haematological values of WAD pregnant goats at the onset and after epidural anaesthesia

| Parameters | Onset | Post anaesthesia | | |
|---------------------------------|-------------|-------------------------|-------------------------|-------------------------|
| | | 1 hour | 2 hours | 3 hours |
| PCV (%) | 36.75±0.47 | 38.5±0.65 | 35.25±0.47 [#] | 35±0.41 [#] |
| Hb (gm/l) | 12.7±0.13 | 13.18±0.15 | 12.4±0.33 | 11.83±0.08 [#] |
| Wbc (cell/mm ³) | 7353±62.63 | 7868±90.68 [#] | 6650±193.6 [~] | 6858±40.49 [~] |
| Rbc (cell/mm ³) | 7925±268.9 | 9078±147.2 [#] | 7113±139 [~] | 7410±134.2 |
| Platelet(cell/mm ³) | 295750±2175 | 261250±2045 | 198875±427 [#] | 288500±7890 |
| Neutrophils (%) | 70.55±0.65 | 60.75±0.85 [~] | 69.25±2.28 [#] | 60.5±0.65 [~] |
| Lymphocytes (%) | 29.5±0.65 | 38±1.08 [~] | 34.75±0.47 [~] | 38.25±0.85 [#] |

*P<0.05 when compared with the onset value. #P<0.05 when compared with 1 or 2 hours post anaesthesia

Table 2: Biochemical values of WAD pregnant goats at the onset and after epidural anaesthesia

| Parameters | Onset | Post-anaesthesia | | |
|--|------------|------------------|------------|-------------------------|
| | | 1 hour | 2 hours | 3 hours |
| Glucose (mg/dl) | 51.5±1.3 | 48.25±0.85 | 49.75±0.85 | 59.5±0.65 [#] |
| Na ⁺ (mmol/L) | 134.8±0.47 | 135.3±0.47 | 135.8±0.47 | 137.3±0.47 [#] |
| K ⁺ (mmol/L) | 3.37±0.04 | 3.27±0.04 | 3.37±0.08 | 3.7±0.12 [#] |
| Cl ⁻ (mmol/L) | 102.5±1.04 | 102.8±1.1 | 102.5±1.04 | 107.3±1.1 [#] |
| HCO ₃ ⁻ (mmol/L) | 24.5±0.65 | 24.5±0.65 | 24.5±0.65 | 23.5±0.65 [#] |
| Urea (mg/dl) | 13.75±0.47 | 13±0.41 | 14±0.41 | 16.25±0.48 |
| Creatinine (mg/dl) | 0.4±0.04 | 0.47±0.04 | 0.47±0.04 | 0.5±0.04 |

*P<0.05 when compared with the onset value. #P<0.05 when compared with 1 or 2 hours post anaesthesia administration

epidural block (Ghadirian and Vesal, 2013). There is dearth of information on the measurement of haemato-biochemical parameters following epidural lidocaine with epinephrine in animal studies especially in pregnant goats. In the present study, the decrease in hematological parameters including Hb, PCV, RBCs, Neutrophil and platelets after epidural analgesia might be due to shifting of fluids from extravascular compartment to intravascular compartment to compensate normal cardiac output (Wagner *et al.*, 1991) and pooling of blood cells in the reservoir organs like spleen (Sharda *et al.*, 2008). There could also be redistribution of blood to vital organs during the anaesthetic state of the animal. This finding is similar to previous findings after epidural xylazine combined with lignocaine in cow calves (Moulvi *et al.*, 2011), epidural tramadol-lidocaine combination in buffalo calves (Atiba *et al.*, 2015) and after epidural lidocaine-neostigmine combination in buffalo calves (Ghazy *et al.*, 2015).

A significant increase in glucose levels was observed after 3 hours post administration. The glucose, sodium ion, potassium ion, chloride ion, bicarbonate ion increased significantly (P<0.05) at the third hour post administration while the urea and creatinine level did not show any significant change. Mirakhor *et al.* (1984)

suggested that mild increase in glucose may be due to a rise in adrenocortical hormones during stress. Mild hyperglycemia has been related to an increase in adrenaline and/or corticosteroids secretion (Carrol *et al.*, 1997). The relative stability in urea and creatinine level showed that there was no impairment of the kidney function. Physiological parameters, including heart rate, respiration rate and temperature are complex variables that can be altered by fear, stress, degree of anaesthesia, vascular volume, ambient temperature, muscular activity and metabolism (Keskin *et al.*, 2006; Habibian *et al.*, 2011; De Rossi, *et al.*, 2012) but are not consistent or reliable indicators of pain (Conzemius *et al.*, 1997). As observed in this study (Table 3), the decrease in heart rate may be attributed to increased parasympathetic activity and decreased sympathetic outflow from central nervous system (Greene and Thurmon, 1988). A significant portion of the chronotropic and inotropic control of the heart is mediated by afferent and efferent fibers carried through the reflex arch in the upper five thoracic spinal segments. Animal studies have confirmed a clear effect of thoracic epidural anaesthesia on cardiac electrophysiology. A reduction of heart rate, prolonged AV nodal conduction time and refractoriness and decreased arterial blood pressure were found when

Table 3: Physiological values WAD pregnant goats at the onset and after epidural anesthesia

| Parameters | Onset | Post-anaesthesia | | | | | |
|-----------------------|-------|------------------|-------|-------|--------|--------|--------|
| | | 30min | 60min | 90min | 120min | 150min | 180min |
| Heart rate (beat/min) | 140 | 112 | 112 | 112 | 128 | 116 | 128 |
| Respiratory rate() | 41 | 44 | 28 | 32 | 32 | 68 | 80 |
| Rectal temperature | 38.7 | 39.4 | 39.5 | 39.7 | 39.8 | 39.9 | 40 |

thoracic epidural anaesthesia was added to intravenous injection of atenolol, suggesting a mechanism of decreased β -receptor stimulation (Hotvedt *et al.*, 1984). It could be concluded from this study that the epinephrine-lidocaine solution for epidural anaesthesia provided a prolonged duration of action without much effects on hematology, biochemical and physiological parameters in pregnant goats. However, the electrolyte results call for caution and monitoring in animals with a pre-existing metabolic disorder. This study will serve as reference point for surgeons when operating on pregnant animals under epidural anaesthesia especially during caesarean section and rectal tear repairs. However, future studies could vary the concentration of the added epinephrine and evaluate their corresponding effects both in pregnant and non-pregnant animals.

References

- Carpenter RE, Wilson DV, Evans AT (2004). Evaluation of intraperitoneal and incisional lidocaine or bupivacaine or analgesia following ovarihysterectomy in the dog. *Anaesthesia and Analgesia*; 31: 46-52.
- Carrol GL, Hartsfield SM, Hambleton R (1997) Anesthetic effects of tiletamine-zolazepam, alone or in combination with butorphanol, in goats. *JAVMA*; 211:593–597
- Coles EH (1989). *Veterinary Clinical Pathology*, 4th edition (W.B. Saunders Co., USA, 1989).
- Conzemius MG, Hill CM, Sammarco JL, Perkowski SZ (1997). Correlation between subjective and objective measures used to determine severity of postoperative pain in dogs. *J. Am. Vet. Med. Assoc*; 210: 1619-1622.
- De Rossi R, Silva-Neto AB, Pompermeyer CTD, Frazílio FO, Paulo HA, Jardim ACL (2012). The efficacy and safety of levobupivacaine administered by lumbosacral epidural route in conscious sheep. *Res. Vet. Sci.*; 92: 278-282.
- Dunlevy TM, O'Malley TP, Postma GN (1996). Optimal concentration of epinephrine for vasoconstriction in neck surgery. *Laryngoscope*; 106:1412-4.
- Elmore RG (1980). Food animal regional anesthesia. Bovine blocks. *Epidural. Vet. Med. Small Anim. Clin.*; 75: 1017-1029.
- Folwaczny C, Heldwein W, Obermaier G, Schindlbeck N (1997). Influence of prophylactic local administration of epinephrine on bleeding complications after polypectomy. *Endoscopy*; 29:31-3.
- Ghadirian S, Vesal N (2013) "Brachial plexus block using lidocaine/epinephrine or lidocaine/xylazine in fat-tailed sheep," *Veterinary Research Forum*; 4(3): 161–167.
- Ghazy A, Atiba A, Shukry M, Kamal T (2015) "Comparison of Lidocaine and Lidocaine-Neostigmine for epidural analgesia in water buffalo calves (*Bubalus Bubalis*)," *Alexandria Journal of Veterinary Sciences*; 46(1): 177–181.
- Greene SA, Thurmon JC, Xylazine (1988). A review of its pharmacology and use in veterinary medicine. *J Vet Pharmacol Ther.*; 11:295-313.
- Habibian S, Bigham AS, Aali E (2011). Comparison of lidocaine, tramadol and lidocaine-tramadol for epidural analgesia in lambs. *Res. Vet. Sci*; 91: 434–438.
- Hall LW, Clark KW (1991). *Veterinary Anaesthesia*, 9th ed. Balliere Tindal. London.
- Hotvedt R, Refsum H, Platou ES (1984). Cardiac electrophysiological and hemodynamic effects of beta-adrenoceptor blockade and thoracic epidural analgesia in the dog. *Anesth Analg*; 63:817-24.
- Jain NC, Schalm (1986). *Veterinary Haematology*, 4th edn. (Lea and Febiger, USA).
- Keskin M, Biçer O, Gül S, Sarı A (2006). A study on comparison of some physiological adaptation parameters of different goat genotypes under the eastern Mediterranean climatical condition. *Hayvansal Üretim*; 47: 16-20.
- Koay J, Orengo I (2002). Application of local anesthetics in dermatologic surgery. *Dermatol Surg*; 28:143-8.
- Mirakhor KK, Solti VK, Nigam JM (1984). "Effect of thiopentone anaesthesia on plasma catecholamine and cortisol in buffalo calves (*Bubalus bubalis*)," *Indian Journal of Veterinary Surgery*; 3(2): 86–88.
- Moulvi BA, Parrah JD, Kalim MO, Athar H, Dedmari FH (2011). "Haemato-biochemical response to lignocaine alone or in combination with xylazine for epidural analgesia in cow calves," *J of Adv Vet Res*; 1:17– 20.
- Roy AC, Islam R, Hossain MK, Lucky NS, Akanda R, Paul B, Hasan I, Mahfuz SU, Uddin F, Roy S (2015). Effects of various local analgesics and ketamine for cranial epidural analgesia in Black Bengal Goats. *Intl J Biol Res*; 3 (1): 19-24
- Sakura S, Sumi M, Morimoto N, Saito Y (1999). The addition of epinephrine increases intensity of sensory block during epidural anesthesia with lidocaine. *Reg Anesth Pain Med*; 24: 541–6
- Schalm OW, Jain NC, Carrol E (1975). *Veterinary Haematology 3rd Edition* Lea and Febiger, Philadelphia USA, 160-210
- Sharda R, Dutta GK, Tiwari SK, Sharda N (2008). "Effect of xylazine, ketamine and their combination as epidural anaesthesia in buffalo calves," *Indian Veterinary Journal*; 85(6): 608–610.
- Sinnott CJ, Cogswell LP III, Johnson A, Strichartz GR. (2003) On the mechanism by which epinephrine potentiates lidocaine's peripheral nerve block. *Anesthesiology*; 98: 181–8
- Skarda RT, Tranquilli WJ (2007). Local and regional anesthetic and analgesic techniques: Ruminant and swine. In: Tranquilli WJ, Thurmon JC, Grimm KA, editors. *Lumb & Jones' veterinary anesthesia and analgesia*. 4th ed. Ames, IA: Blackwell Publishing; p. 643–681.
- Skarda RT, Tranquilli WJ (2007). Local anesthetics. In: Tranquilli WJ, Thurmon JC, Grimm KA (Eds.). *Lumb & Jones' veterinary anesthesia and analgesia*. 4th ed. Ames, IA, USA: Blackwell Publishing; 395-418.
- Skarda RT (1996): Local and regional anesthesia in ruminants and swine. *Anesthesiology update. Vet. Clin. North Am. Food Anim. Pract.*; 12: 579-662.
- Trim CM (1981). Sedation and general anaesthesia in ruminants. *Calif. Vet*; 4: 29-36.
- Wagner AE, Muir WW III, Hinchcliff KW (1991). "Cardiovascular effects of xylazine and detomidine in horses," *American J. Vet. Res*; 52(5): 651–659.