Haryana Vet. (June, 2021) **60(1),** 115-118 **Research Article**

EVALUATION OF THE ISOFLURANE SPARING EFFECT OF MELOXICAM IN BUFFALOES UNDERGOING DIAPHRAGMATIC HERNIORRHAPHY

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ABSTRACT

This study analysed the isoflurane sparing effect of meloxicam in buffaloes undergoing diaphragmatic herniorrhaphy. Ten buffaloes operated for diaphragmatic hernia under general anaesthesia were randomly divided in two groups of five buffaloes each. All the buffaloes were premedicated with inj. atropine @ 0.04 mg kg^{-1} and inj. Xylazine @ 0.05 mg kg^{-1} I.M. In the group II, fifteen minutes after premedication, inj. meloxicam @ 0.5 mg kg^{-1} was administered intravenously. However, no analgesic was given in the group I (Control Group). Anaesthesia was induced in both groups with inj. Propofol (till effect) I.V. and was maintained with isoflurane in 100% oxygen with variable vaporizer setting for uniform surgical plane of anaesthesia. The quantity of isoflurane utilized (in ml) was calculated by summing up the isoflurane vapour delivered for each of the fresh gas flow and vaporizer setting employed. The quantity of isoflurane so obtained was equated to 400 kg body weight of animals and 40 minutes duration of anaesthesia for statistical comparison. The addition of meloxicam resulted in 31.47% reduction in quantity of isoflurane required for buffaloes undergoing diaphragmatic herniorrhaphy as compared to the animals of another group where meloxicam was not used.

Keywords: Buffaloes, Diaphragmatic herniorrhaphy, Isoflurane, Meloxicam, Sparing effect

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Diaphragmatic hernia (DH) is a common sequal of foreign body syndrome in buffaloes. The repair of the diaphragmatic defect needs general anaesthesia along with controlled ventilation (Singh *et al.*, 2006) as thoracic cavity is entered. General anaesthesia in bovines requires multiple drug approach i.e. balanced anaesthesia to avoid different complications like excessive salivation, regurgitation, tympany and cardiopulmonary depression (Lundy, 1926). So, it becomes imperative to evaluate different drugs combinations before clinical use.

Sparing effect is the effect of a less essential drug in the balanced anaesthesia, such that it decreases the requirement and the side effects of essential drug. The reduction in isoflurane requirements for maintaining general anaesthesia is important as the use of less isoflurane will reduce isoflurane-related adverse effects like respiratory depression, hypotension and decreased cardiac output (Hikasa *et al.*, 2002). Using less isoflurane also reduces the hazard of atmospheric pollution (Joubert, 1999). So, to optimize the safety of patients during general anaesthesia, the amount of inhalation agent should be minimized by addition of analgesics. Meloxicam is a commonly used pre-emptive and post-operative analgesic in veterinary practice. It is cheaper and easily available than opioids. Patricia *et al.* (2006) reported that there was greater reduction in MACiso (Minimum alveolar concentration of isoflurane) when animals were pre-medicated with meloxicam than butorphanol alone in rabbit anaesthesia.

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Therefore, the present study was designed with the objective to evaluate the isoflurane sparing effect of meloxicam in buffaloes undergoing diaphragmatic herniorrhaphy.

MATERIALS AND METHODS

The study was conducted, with consent of owners, on ten clinical cases of buffaloes undergoing diaphragmatic herniorrhaphy under general anaesthesia. The radiographically or ultrasonographically diagnosed cases of DH were subjected to rumenotomy to completely evacuate the ruminal contents and to remove the foreign bodies, if present, in the herniated or non-herniated reticulum. The buffaloes were not allowed to access feed or water after rumenotomy till general anesthesia was induced 24 hrs later.

The buffaloes were weighed (320 ± 170 kg) before undergoing herniorraphy for calculating the dose of drugs for general anaesthesia. Animals were randomly divided in two groups having five animals each. Time and route of drug administration is given in table 1 (Chaudhary *et al.*, 2017; Chaudhary and Tayal, 2020). In group I, no analgesic was used while in group II, inj. meloxicam @ (0.5mg/kg b.wt.) was used as analgesic intravenously. After induction, intubation was performed with cuffed endotracheal tube of inner diameter 20 mm and was connected to Vetland® (Veterinary anaesthesia system,

Table1

Time and route of drug administration along with dose rate in buffaloes undergoing diaphragmatic herniorraphy

Drug	Dose Rate	Time and route of administration of different drugs
Atropine	0.04 mg/kg	Atropine(I/M)
		↓10 min
Xylazine	0.05 mg/kg	Xylazine/(I/M)
		↓15 min
Meloxicam	0.5mg/kg	No analgesic (Group I)/ Meloxicam (I/V) (Group II)
		↓5 min
Propofol	till effect	Propofol (I/V)
		↓5 min
Isoflurane	0-5%	Isoflurane

Vetland medical sales and services, L.L.C., USA) large animal anaesthesia machine. For maintenance of anaesthesia, isoflurane was administered through agent specific vaporizer along with oxygen using a semi-closed rebreathing system.

The oxygen flow rate was @ 10 litres per minute for first 3 minute, then reduced to 6 litres along with variable vaporizer setting to maintain surgical plane of anaesthesia. Animals were placed in dorsal recumbency for post-xiphoid trans-abdominal approach of diaphragmatic herniorrhaphy. Concentration of inhalation anaesthetic agents was regulated to maintain adequate depth of anaesthesia by monitoring body reflexes (corneal, palpebral, swallowing and cutaneous twitching) and buffaloes response to surgical stimulation. Vital parameters like respiration rate, heart rate, SpO_2 and rectal temperature were monitored during entire period of anaesthesia using Edan Vet®multi-parameter monitor. Quality and depth of anaesthesia were evaluated through a blind fold study by a single individual. Scoring was done to assign numerical values; starting from 1 to 4 (1-poor, 2-fair, 3-good, 4-excellent) for premedication quality, induction quality, maintenance quality and recovery quality. Qualitative and subjective effects (sedation, analgesia, muscle relaxation) of drugs were judged by observing physical response of the medicated animal to surgical stimulation during diaphragmatic herniorrhaphy. Numerical values starting from 0 to 3 (0-no effect, 1-mild effect, 2-moderate effect, 3-deep effect) were used for sedation, analgesia and muscle relaxation during maintenance of anaesthesia. Inhalation of anaesthetic agent was discontinued at the application of last skin suture. Animals were not hyperventilated at the time of last suture in diaphragm as negative pressure in pleural cavity was created through suction machine. All the animals were administered normal saline in jugular vein throughout the period of surgery by using 16 gauze needles. The animals were monitored until complete recovery without ataxia. The dial setting of vaporizer was different in different animals at end as per the requirement to maintain surgical plane of anaesthesia. The animals of group I were administered with meloxicam at recovery. Buffaloes were also observed for any difference in recovery.

Calculation of amount of liquid isoflurane utilized: The changes made in the fresh gas flow rate and vaporizer setting at various times were recorded. The total duration of anaesthesia in minutes was recorded from the time of turning on to off the vaporizer. The data so obtained were used for calculating the quantity of isoflurane consumed for the different anaesthetic combinations by following formula (Senthilkumar *et al.*, 2013).

Isoflurane vapour delivered (mL) = Vapourizer setting (%) × Fresh gas flow (Litre per minute) × Duration (min) × 10

The total isoflurane vapour delivered (mL) for the total duration of anaesthesia was calculated by summing up the isoflurane vapour delivered for each of the fresh gas flow (FGF) and vapourizer setting employed. The total isoflurane vapour value so obtained was equated to 400 kg body weight as 400 kg is an average weight of buffaloes and 40 minutes duration as it brings uniformity in data obtained for different cases in practical but theoretically for the same time in different animals. Hence, such equation for common weight and time duration makes data uniform and this sets basis for statistical comparison as

Table 2

Amount of isoflurane utilized (on 400 kg and 40 min basis in ml) by individual buffaloes of group Iand II during diaphragmatic herniorrhaphy

Animals	Isoflurane liquid utilized (ml)	
	Group I	Group II
Animal A	94.00	48.00
Animal B	62.93	32.43
Animal C	41.25	33.39
Animal D	56.76	78.78
Animal E	73.00	31.55
Mean ± S.E.	65.58±8.77	44.83±9.01

percentage reduction in isoflurane utilized in group II from group 1=31.7%

Table 3

Effects of anaesthetic combinations of group I and group II on (Mean ± S.E.) different parameters in buffaloes undergoing diaphragmatic herniorrhaphy

Parameter	Groups	Diaphragmatic herniorrhaphy				
		Before drug admn.	At 5 min. of propofol	At 15 min. of isoflurane	At 30 min. of isoflurane	At Recovery
Rectal Temp. (°C)	I (AXPI)	36.70±0.27	36.92±0.32	37.06±0.28	37.04±0.29	36.98±0.33
	II(AXMPI)	36.22±0.65	36.24±0.60	36.28±0.60	36.32±0.59	36.62±0.55
Heart Rate (beat /min.)	I (AXPI)	49.6±1.02	49.0±1.83	48.8±2.59	51.0±1.34	49.8±0.86
	II(AXMPI)	48.0±1.37	52.8±1.52	53.8±1.56	56.8±1.11	51.2±1.49
Respiratory Rate (breath/min.)	I (AXPI)	12.00±0.63	11.40±0.24	11.40±0.40	11.80±0.48	11.40±0.40
	II(AXMPI)	11.80±0.37	11.60±0.87	12.40±0.50	10.80±1.15	12.40±0.81
SpO_2 (%)	I (AXPI)	98.0±0.80	96.8±1.30	96.4±1.70	96.8±1.20	97.2±0.80
	II(AXMPI)	96.4±1.20	93.4±3.40	89.8±3.80	89.0±3.60	93.6±1.20

Table 4

Weight (kg) and duration of anaesthesia (minutes) of buffaloes of group I and group II

Animal	Group I (AXPI)		Group II (AXMPI)	
	Weight	Duration of anaesthesia	Weight	Duration of anaesthesia
1	305	43	268	55
2	355	55	310	53
3	327	43	273	56
4	332	54	245	41
5	296	44	315	43

follows:

$$\text{Isoflurane vapour delivered for 400 kg and 40 minutes basis (mL)} = \frac{\text{Total isoflurane vapour delivered (mL)} \times 400 \times 40}{\text{Body weight (kg)} \times \text{Duration of maintenace (minutes)}}$$

Using Avagadro's principle, it was calculated in liquid volume of isoflurane (in ml) and the effect of ambient temperature and pressure were neutralized as follows:

= (Isoflurane vapour delivered for 400 kg and 40 min basis (ml) × 181.4) × ambient temp/273) ×(760/barometric pressure)

The statistical analysis of data was done by one-way-analysis of variance (ANOVA) and Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The amount of isoflurane utilized (on 400 kg and 40 min basis in mL) by individual buffalo is shown in table 2. It was observed that volume of isoflurane utilized (Mean ± S.E.) in group I was 65.58 ± 8.77 mL and in group II was 44.83 ± 9.01 mL. There was a non-significant difference between the amount of isoflurane utilized between two groups but otherwise, 31.7% reduction in isoflurane utilized was recorded in group II from group I (Fig.1). There was no significant difference between the vital physiological parameters (Rectal temperature, RR, HR, SpO_2) as well as in the recovery (Table 3).

When an inhalational drug such as isoflurane is used as sole agent, it is often not sufficient to abolish the desired autonomic and nociceptive responses to the surgical stimulus, potentially leading to inadequate peri- and post-operative analgesia (Steffey and Mama, 2007). Continuous rate infusion of lidocaine at a dose of 50 mg/kg/minute in calves significantly decreased isoflurane requirement by 16.7% (Vesal *et al.*, 2011). The effects of analgesics on the MAC of volatile anaesthetic have also been investigated (Patricia *et al.*, 2006) but there is paucity of literature on isoflurane sparing effect of meloxicam in buffaloes. Doherty *et al.* (2004) reported that the MAC of isoflurane decreased by 29.4% after administration of morphine plus flunixine (1.5 mg/kg body weight) in dogs.

Since each anaesthetic has its own pharmacodynamics and pharmacokinetic merits and demerits, it is prudent to achieve surgical anaesthesia by combination of various agents (balanced anaesthesia) to overcome the undesirable action of each agent, if any. However, the reduction in quantity of isoflurane in group II was not significant in comparison to buffaloes of group I but its combination with opioids might have potentiated the sparing effect of opioids in buffaloes as reported in dogs and rabbits (Patricia *et al.*, 2006; Ko *et al.*, 2000). So, it is concluded that meloxicam alone did not have significant isoflurane sparing effect in buffaloes but may be included in balanced anaesthetic protocol for buffaloes undergoing long duration surgeries like DH to reduce the quantity of isoflurane required for maintenance.

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