EVALUATION OF EPIDURAL ANAESTHESIA WITH LIGNOCAINE – XYLAZINE MIXTURE IN KETAMINE – SEDATED CATS

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ABSTRACT:
Effects of the epidural administration of 2mg/kg lignocaine – 1.5mg/kg xylazine mixture (LIG–XYL) were compared with the epidural administration of either 4mg/kg lignocaine alone (LIG) or 3mg/kg xylazine alone (XYL) in 5 cats. The cats were premedicated with intramuscular injection of atropine sulphate (0.04mg/kg) and ketamine hydrochloride (10mg/kg). Onset of analgesia, duration of analgesia, duration of recumbency and time to walking were determined. Changes in heart rate (HR), respiratory rate (RR) and rectal temperature (RT) associated with the epidural block were recorded at 10-min intervals over a 120-min time period.
Epidurally administered LIG-XYL produced similar onset of analgesia (4.2±0.3min) to LIG (3.9±1.0min) and XYL (4.8±0.4min). Duration of analgesia with LIG-XYL (86.6±4.1min) was significantly ($P<0.05$) longer than with LIG (40.2±1.0min) but similar to that with XYL (92.7±5.9min). Duration of recumbency of 113.7±6.0min with LIG-XYL was longer than 64.0±1.9min with LIG but shorter than 147.4±15.8min with XYL. However, similar times to walking were found with LIG-XYL (8.4±1.8min), LIG (9.6±2.6min) and XYL (9.6±2.8min). Lower heart and respiratory rates were produced by LIG-XYL and XYL than by LIG.
It was concluded that the epidural administration of LIG-XYL produced longer duration of analgesia, profound sedation and systemic depression similar to XYL but greater than that of LIG. LIG-XYL also had shorter duration of recumbency than XYL.

INTRODUCTION

Epidural anaesthesia may be used for any surgical procedure caudal to the diaphragm in the critically ill animal, particularly where appropriate anaesthetic delivery apparatus is not readily available (1,2,3). However, awake cats often resist handling for clinical procedures without additional chemical restraint (3). In view of its rapid onset of action and wide safety margin, ketamine is frequently used as a chemical restraining agent for this purpose (4).
The use of epidural analgesia with lignocaine (LIG), amethocaine, xylazine (XYL), medetomidine, morphine and pethidine have been described in the cat (5,6,7,8). The ideal epidural anaesthetic solution should combine rapid onset of action, long duration of analgesia and muscle relaxation with rapid reversal of block at the end of the procedure (9). However, no single anaesthetic drug in current use possesses all these qualities. Lignocaine has been widely used in all species because of its excellent diffusing and penetrating properties as well as rapid onset of surgical analgesia. However, its action is too short lived to be used for major procedures (2,3,7,8,10). Epidural administration of XYL has also been reported in cats by Adetunji and others (7). In search for an ideal epidural anaesthetic, synergism between LIG and XYL have been demonstrated in various species of animals (2,3,11, 3, 11). For instance, a combination of LIG and XYL has been reported in Ilamas (12), in horses (13), in goats (14), in cattle (15,16,17,18) and in dogs (19). To date, epidural injection of such this drug mixture is has yet to be reported in the cat.
The aim of this study was therefore to compare the effects of epidurally administered LIG-XYL with either LIG or XYL in ketamine-sedated cats with regard to: time to onset and duration of analgesia, duration of recumbency and time to walking. The associated changes in heart rates (HR), respiratory rates (RR) and rectal temperature (RT) were also noted. The trials were carried out in the absence of any manipulative or surgical procedures.

MATERIALS AND METHODS

Experimental Animals

Five clinically normal adult local Nigerian cats (2 intact toms and 3 non-pregnant, non-lactating queens) having a mean (±SEM) body weight of 1.8±0.1kg were used for the study. The cats were fed with household food and water was provided ad libitum. The animals were stabilized over a period of four weeks. Health status of the cats was assessed by means of physical examination, a complete blood count and selected serum biochemical analyses just before the trials.

Experimental Design

Three series of trials were carried out on each cat in a random fashion at 1- week intervals. The first series involved lumbosacral epidural administration of lignocaine alone (LIG); the second series involved similar administration of xylazine alone (XYL); while the third series involved similar administration of lignocaine–xylazine mixture (LIG-XYL) at half their doses when used alone.

Experimental Procedure

Prior to the trials, food was withheld from the cats for 12 hours (i.e. overnight). Water was allowed free choice until premedication to prevent preanaesthetic dehydration in the cats. Each cat was premedicated by the intramuscular injection of 10mg/kg of 5 percent ketamine hydrochloride (Ketmin®, Laborate Pharmaceutical, India) and 0.04mg/kg of 0.1 percent atropine sulphate (Amopin®, Ningbo Chemicals International Trade Corporation, China) in the same syringe. Following obvious sedation, the cat was positioned in sternal recumbency. The lumboscral epidural region was clipped and aseptically prepared for epidural puncture. The hindlimbs were directed cranially and the epidural injection was then carried out as described for cats by Hall and otherset al. (3). Each cat was given either 4mg/kg of 2 percent LIG (Sensinil®, Claris Lifesciences Limited, India), 3mg/kg of 2 percent XYL (Xylax®, Farvet Laboratories, Holland) or 2mg/kg of 2 percent LIG-1.5mg/kg of 2 percent XYL mixture (LIG-XYL) at 1- week interval. The cats were restrained in sternal recumbency throughout the period of the experiment thereby keeping the spine horizontal for bilateral block. The development of sensory blockade (analgesia) was assessed by the cat's response to clamping the toe- web with a haemostatic forceps to the first ratchet.

Measured Physiological Variables

In the course of the experiments, the cat's HR, RR and RT were measured immediately before the epidural injection (time 0) and subsequently at 10-min interval over a period of 120-min. The HR was determined in beats/min with the aid of a precordial stethoscope. The RR was counted in breaths/min by visual observation of chest excursions. The RT was measured in degrees Celsius (^{o}C) using digital clinical thermometer.

Calculated Anaesthetic Indices

The epidural anaesthetic indices calculated for each cat included: time to onset of analgesia, duration of analgesia, duration of recumbency and time to walking. These indices are defined as follows:

1. Time to onset of analgesia: Time interval (in minutes) from epidural injection to disappearance of the pedal reflex;

2. Duration of analgesia: Time interval (in minutes) from disappearance to reappearance of the pedal reflex;

3. Duration of recumbency: Time interval (in minutes) from ketamine-induced recumbency to when the stood;

4. Time to walking: Time interval (in minutes) between standing and walking.

Data Analysis

The data are expressed as mean ± SEM of 5 cats. Anaesthetic indices of the epidural LIG-XYL, LIG and XYL are compared using one way ANOVA followed by Bonferroni t procedure when a significant difference was indicated. Physiological variables are compared using analysis of variance (ANOVA) for repeated measures. Dunnett's test was used as post test (20). All the values of $P< 0.05$ were considered significant.

RESULTS

Calculated anaesthetic indices

Epidurally administered LIG-XYL produced similar onset of analgesia (4.2±0.3min) to LIG (3.9±1.0min) and XYL (4.8±0.4min). Duration of analgesia with LIG-XYL (86.6±4min) was significantly ($P<0.05$) longer than that with LIG (40.2±1.0min) but similar to that with XYL (92.7±5.9min). Duration of recumbency of 113.7±6.0min with LIG-XYL was longer than 64.0±1.9min with LIG but shorter than 147.4±15.8min with XYL. However, times to walking with LIG-XYL (8.4±1.8min) was similar to those with LIG (9.6±2.6min) and XYL (9.6±2.8min).

Measured physiological variables

Mean HR with LIG-XYL ranged from 101.6±6.9 to 185.6±18.3 beats/min, with LIG from 200.0±8.1 to 237.6±11.2 beats/min and with XYL from 88.8±6.8 to 201.6±18.7 beats/min. Ranges of the mean RR for the treatment groups were from 20.6±2.0 to 36.0± 4.0 breaths/min (LIG-XYL), from 31.2±5.6 to 54.0± 8.2 breaths/min (LIG) and from 21.6±1.9 to 30.4± 2.0 breaths/min (XYL). Mean RT with LIG-XYL ranged from 36.1±0.4 to 38.0±0.2 ^{o}C, with LIG from 38.1±0.5 to 39.1±0.4 ^{o}C and with XYL from 36.2±0.3 to 38.3±0.2 ^{o}C (Tables 1-3).

Table1:
Comparison of mean HR of epidural anaesthesia With LIG[a], XYL[b] and LIG-XYL[c] mixture in five ketamine - sedated cats.

Time interval(min)	HR (beats/min)		
	LIG	XYL	LIG-XYL
0	233.6 ± 15.9+	201.6 ± 18.7	185.6 ± 18.3
10	210.4 ± 11.2+	136.8 ± 6.3*	131.2 ± 8.7*
20	220.8 ± 11.0+	133.6 ± 10.1*	121.6 ± 6.8*
30	210.4 ± 17.0+	117.6 ± 9.7*	116.8 ± 6.6*
40	212.0 ± 13.3+	113.2 ± 7.7*	111.2 ± 6.8*
50	200.0 ± 8.1*+	106.4 ± 8.1*	105.6 ± 6.4*
60	220.4 ± 10.5+	101.6 ± 8.6*	101.6 ± 5.3*
70	226.4 ± 13.1+	96.8 ± 7.3*	103.2 ± 7.1*
80	212.8 ± 4.9+	96.8 ± 9.4*	101.6 ± 6.9*
90	225.6 ± 5.2+	92.8 ± 7.1*	110.4 ± 14.6*
100	219.2 ± 15.3+	90.4 ± 8.5*+	108.4 ± 8.5*
110	229.6 ± 15.1+	88.8 ± 6.8*+	107.2 ± 6.0*
120	237.6 ± 11.2+	96.0 ± 11.6*	113.6 ± 6.8*

Data are expressed as mean ± SEM of 5 cats
a = 4mg/kg, 2% solution
b = 3mg/kg, 2% solution
c = 2mg/kg, LIG – 1.5mg/kg, XYL
* = Significantly different from 0 min in each group;
+ = significantly different from LIG–XYL (P< 0.05).

Table2:
Comparison of mean RR of epidural anaesthesia with LIG[a], XYL[b] and LIG-XYL[c] mixture in five ketamine-sedated cats.

Time interval(min)	RR (breaths/min)		
	LIG	XYL	LIG-XYL
0	31.2 ± 5.6	30.4 ± 2.0	26.0 ± 2.4
10	32.8 ± 5.6+	21.6 ± 1.9*	21.6 ± 2.8
20	42.0 ± 6.8+	22.0 ± 1.1*	20.6 ± 2.0*
30	34.4 ± 6.8+	23.6 ± 3.0*	22.2 ± 2.5
40	40.8 ± 12.1+	25.2 ± 2.7*	22.2 ± 2.1
50	47.2 ± 7.6*+	27.6 ± 5.4+	22.8 ± 1.8
60	45.2 ± 9.9+	25.6 ± 2.5*	25.6 ± 3.0
70	54.0 ± 8.2*+	26.4 ± 2.9	26.4 ± 2.7
80	48.2 ± 6.8* +	27.6 ± 1.8+	24.0 ± 1.2
90	44.8 ± 7.6*+	24.8 ± 2.0*	24.8 ± 1.5
100	40.4 ± 5.4	24.0 ± 1.1*+	33.2 ± 4.9
110	41.6 ± 7.6+	25.8 ± 1.7*	28.8 ± 2.5
120	42.0 ± 6.0	25.6 ± 0.8*+	36.0 ± 4.0*

Data are expressed as mean ± SEM of 5 cats
a = 4mg/kg, 2% solution
b = 3mg/kg, 2% solution
c = 2mg/kg, LIG – 1.5mg/kg, XYL
* = Significantly different from 0 min in each group;
+ = significantly different from LIG–XYL (P< 0.05).

Table3:
Comparison of mean RT of epidural anaesthesia With LIG[a], XYL[b] and LIG-XYL[c] mixture in five ketamine - sedated cats.

Time interval(min)	RT ^{o}C		
	LIG	XYL	LIG-XYL
0	38.7 ± 0.3+	38.3 ± 0.2	38.0 ± 0.2
10	38.4 ± 0.4	38.0 ± 0.2	37.8 ± 0.2
20	38.3 ± 0.4	37.8 ± 0.2*	37.6 ± 0.3
30	38.1 ± 0.4+	37.6 ± 0.3*	37.3 ± 0.3*
40	38.1 ± 0.5+	37.4 ± 0.3*	37.2 ± 0.3*
50	38.1 ± 0.4+	37.1 ± 0.3*	37.0 ± 0.6*
60	38.2 ± 0.4+	36.9 ± 0.3*	36.8 ± 0.3*
70	38.5 ± 0.5+	36.8 ± 0.3*	36.6 ± 0.4*
80	38.6 ± 0.5+	36.7 ± 0.3*	36.4 ± 0.4*
90	38.7 ± 0.4+	36.5 ± 0.3*	36.3 ± 0.4*
100	38.9 ± 0.4+	36.3 ± 0.4*	36.2 ± 0.4*
110	38.9 ± 0.4+	36.2 ± 0.3*	36.1 ± 0.4*
120	39.1 ± 0.4+	36.2 ± 0.3*	36.3 ± 0.4*

Data are expressed as mean ± SEM of 5 cats
a = 4mg/kg, 2% solution
b = 3mg/kg, 2% solution
c = 2mg/kg, LIG – 1.5mg/kg, XYL
* = Significantly different from 0 min in each group;
+ = significantly different from LIG–XYL ($P< 0.05$).

DISCUSSION

The cat is usually uncooperative when handled for clinical procedures. For this reason, practicing veterinarians often perform epidural block on heavily sedated or lightly anaesthetized animals (1,2,3). Therefore, ketamine hydrochloride (10mg/kg) was used in this study to achieve heavy sedation in the experimental cats, as reported in a previous study (7).

The spread of anaesthetic solution within the epidural space is known to be influenced by a variety of factors including age, obesity, pregnancy and body posture (1,2,3,21). Therefore aged, obese and pregnant cats were excluded from this study in order to obtain valid data for comparison.

Duration of analgesia of 40.2±1.0min produced by epidurally administered LIG in this study is in accord with 37.2± 5.3min reported by Duce et al. (5) and 43.6±5.6min reported by Adetunji et al. (7) in similar studies using LIG without adrenaline. In contrast, epidural administration of LIG with adrenaline produced longer duration of analgesia of 99.3±7.9min (5) as the addition of adrenaline prolonged the block. Also duration of analgesia of 92.7±5.9min produced with epidurally administered XYL in this study was longer than 51.8±6.9min obtained by Adetunji et al. (7). This might be due to the use of a different brand of XYL or an other factor. But onset of analgesia and duration of recumbency of 4.8±0.4min and 147.4±15.8min respectively compare well with respective 5.2±1.4min and 183.8±21.5min as reported by Adetunji et al. (7).

In this study, epidurally administered LIG-XYL produced intermediate systemic depression, LIG the least and XYL the highest, as seen in the mean HR, RR and RT observed (Tables 1-3). The mean HR was observed to be lower in both LIG-XYL and XYL groups than LIG group, probably due to the bradycardic effect of XYL (2,3,7). However, the HR did not drop significantly with epidural LIG probably due to the counteracting inotrophic effects of previously administered atropine sulphate and ketamine hydrochloride. The mean RR was also lower in both LIG-XYL and XYL groups than LIG group probably due to XYL's respiratory depressant effects. This is commonly produced by all alpha2 adrenergic agonists (2,3). The mean RT was observed to show a steady decline per time interval. These can also be attributed to the systemic effect of XYL (2,3).

In conclusion, epidurally administered LIG-XYL produced longer duration of analgesia and more profound sedation than LIG but similar to XYL. There was shorter duration of recumbency with epidural LIG-XYL than with XYL. Also systemic depression with LIG-XYL was not as severe as compared with XYL. Therefore, LIG-XYL approaches the ideal anaesthetic agent as described by Howell (9) more than either LIG or XYL for single-dose epidural administration in cats undergoing longer duration procedures lasting more than 1 hour.

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Cover image - CARACAL | *Felix caracal*
The caracal or desert lynx is a territorial medium-sized feline found throughout the Middle East including Israel, Africa and northern India. The name caracal comes from the Turkish, "karakulak", meaning "black ear". Its main habitat is dry areas and semi-deserts, but it also inhabits woodlands, savannah, and scrub forest. Its life span is about 12 years in nature, and 16-19 years in captivity. It is a nocturnal hunter mainly of hares and birds (in Israel). It is best known for its spectacular skill at hunting birds, being able to snatch a bird in mid-flight.The female gives birth to litters of 1-3 cubs. The gestation period is 69-71 days. The cubs open their eyes at 10 days old and begin to walk a few days later.In Iran and India, the caracal has been trained to hunt.