UNIVERSITI PUTRA MALAYSIA

THE EFFECTS OF LIDOCAINE-BUPIVACAINE BLOCK IN CATS UNDERGOING CASTRATION

NG TUCK CHEOK

TITLE

THE EFFECTS OF LIDOCAINE-BUPIVACAINE BLOCK IN CATS UNDERGOING CASTRATION

NG TUCK CHEOK

A project submitted to the
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In partial fulfillment of the requirement for the
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CERTIFICATION

It is hereby certified that we have read this project paper entitled "The effects of lidocaine-bupivacaine block in cats undergoing castration" by Ng Tuck Cheok and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4901-Project.

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DEDICATION

This thesis is for my mother, brothers, and sisters. The greatest gift they could give is the gift of unconditional love.

ACKNOWLEDGEMENTS

I am very grateful and would like to express my great gratitude to Dr. Chen Hui Cheng for being patient and supportive throughout my project. I would like to give a special appreciation to Dr. Rozanaliza Radzi for giving me support and helping out in my project. They have been invaluable source of guidance and knowledge. I would also like to thank Prof. Mohamed Ariff Omar for his help in statistical analysis and for his wise insights. I would like to thank my siblings, Ng Tuck Keng and Ng Vi-Vian, for their contribution and support. Without them, I would not have completed this project in time. Lastly, I am very thankful for my mother, Looi Lay Ting for her endless support throughout my life.

CONTENTS

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999- Projek

Kesan Penggunaan Blok Lidocaine-Bupivacaine Pada Kucing Yang Dikasi

Oleh

Ng Tuck Cheok

2015

Penyelia: Dr. Chen Hui Cheng

Penyelia bersama: Dr. Rozanaliza Radzi

Kesan sekatan lidocaine-bupivacaine pada kucing yang menjalani rutin pengasian telah ditentukan. Dua belas kucing telah dibahagikan secara rawak kepada dua kumpulan. Kucing dalam Kumpulan 1 (Sekatan setempat, n = 6) , telah diberi campuran 1 mg/kg 2% lidocaine dan 1 mg/kg 0.5 % bupivacaine secara subkutaneus ke dalam pundi skrotum. Kucing dalam Kumpulan 2 (Kawalan, n = 6) tidak menerima sekatan setempat. Kedua-dua kumpulan dibius dengan ketamine-acepromazine intraotot, pada 15 mg/kg dan 0.1 mg/kg masing-masing dan dikekalkan dengan sevoflurane melalui topeng muka. Tekanan darah arteri sistolik (SAP), diastolik (DAP), dan purata (MAP), kadar jantung (HR), dan kadar pernafasan (RR) dipantau sepanjang pembedahan. Selepas pembedahan, semua kucing diberi meloxicam, 0.2 mg/kg secara subkutaneus. Skor kesakitan diperolehi pada 4, 8, dan 24 jam selepas pembedahan.

Nilai-nilai ambang tekanan mekanikal (MPT) diambil pada 2 , 4 , 8 , dan 24 jam selepas pembedahan. Semasa pembedahan, SAP, DAP, MAP, dan HR cenderung untuk menjadi lebih tinggi dalam kumpulan kawalan. Peningkatan dalam kadar jantung memuncak semasa tarikan dan autoligasi kord sperma. Tiada perbezaan rawatan dalam RR. Selepas pembedahan, skor kesakitan dalam kumpulan sekatan setempat adalah lebih rendah daripada kumpulan kawalan pada 4 jam selepas pembedahan. Tiada perbezaan rawatan dalam HR, RR, SAP, DAP, MAP, dan nilai-nilai MPT. Kesimpulannya, penyusupan subkutaneus lidocaine-bupivacaine ke dalam pundi skrotum sebelum pengasian memberi kestabilan hemodinamik intrabedah yang baik dan analgesia yang lebih baik selama 4 jam selepas pengasian.

Kata Kunci: *kucing, pengasian*, *sekatan setempat, lidocaine-bupivacaine, hemodinamik*

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999- Project

The Effects of Lidocaine-Bupivacaine Block in Cats Undergoing Castration

By

Ng Tuck Cheok

2015

Supervisor: Dr. Chen Hui Cheng

Co-supervisor: Dr. Rozanaliza Radzi

The effects of lidocaine-bupivacaine block in cats undergoing routine castration were determined in this controlled, randomized, and blinded study. Twelve cats were randomly assigned to two groups. Cats in Group 1 (Local block, n=6), were given a mixture of 1 mg/kg of 2% lidocaine and 1 mg/kg of 0.5% bupivacaine subcutaneously at the scrotal sac. Cats in Group 2 (Control, n=6) did not receive the local block. Both groups were induced with ketamine-acepromazine intramuscularly, at 15 mg/kg and 0.1 mg/kg respectively, and maintained on sevoflurane via facemask. The systolic (SAP), diastolic (DAP), and mean arterial blood pressure (MAP), heart (HR), and respiratory rate (RR) was measured intra-operatively at specific events. Postoperatively, all cats received meloxicam, 0.2 mg/kg subcutaneously. Pain scores were determined at 4, 8, and 24 hours post-operatively. The mechanical pressure threshold (MPT) values were determined at 2, 4, 8, and 24 hours post-operatively. Intra-operatively, the SAP,

DAP, MAP, and HR tended to be higher in the control group. The hemodynamics peaked during traction and autoligation of the first spermatic cord in the control group. There was no treatment difference in RR. Post-operatively, pain scores in the group given local block were lower than the control group at 4 hours post-operation. There is no treatment difference in post-operative HR, RR, SAP, DAP, MAP, and MPT values. Thus, it can be concluded that subcutaneous infiltration of lidocaine-bupivacaine into the scrotal sac before castration improved intra-operative hemodynamic stability, and provided better analgesia up to 4 hours post-castration.

Keywords: *cat, castration*, *local block, lidocaine-bupivacaine, hemodynamic*

1.0 INTRODUCTION

Castration in male cats under general anaesthesia is frequently performed in veterinary practice. This procedure is assumed to be a mild to moderately painful procedure to warrant the use of peri-operative analgesia (Mathews, 2000). However, there has been limited use of peri-operative analgesia during castration, especially in cats (Hewson *et al.*, 2006). This is because peri-operative pain is often under-estimated in cats (Wright, 2002). Some of the difficulty lies in assessing whether the cat is experiencing pain, as cats usually hide signs of pain.

Intra-operative nociception will stimulate the sympatho-adrenal system, resulting in increased heart rates, blood pressures, and respiratory rates. The commonly used markers of intra-operative nociception are the heart rate and blood pressure (Moldal *et al.*, 2013). The intra-operative condition of the patient should be closely monitored, as significant increase in hemodynamics may indicate inadequate anaesthesia or analgesia.

A certain degree of pain may be experienced by the cat after surgery, although the cat may appear fine. A study done by Smith *et al.* (1996) showed that cats that did not receive analgesics had higher cortisol concentration than cats that receive analgesic after surgery. Pain may increase the potential for secondary problems such as immune suppression, secondary illness, and prolong hospital stay. Mathew (2000) also hypothesized that if acute pain were better controlled, the chronic pain will not develop. This shows the importance of analgesia given peri-operatively.

Local anaesthetic agents can be incorporated into routine castration procedure because of its intra-operative anti-nociceptive effects during castration in other veterinary species. This stability that is produced may reduce the anaesthetic agent used during surgery,

ie. producing anaesthesia sparing effect. A study in dogs showed that intratesticular lidocaine was able to reduce isoflurane requirements in dogs undergoing castration (McMillan *et al.*, 2012). Another study in cats showed that intratesticular and subcutaneous lidocaine infiltration was able to alleviate nociceptive response to surgery (Moldal *et al*., 2013). However, study by Stevens *et al.* (2013) on dogs failed to show that intratesticular lidocaine-bupivacaine improved post-operative pain scores compared to the saline placebo. No study has been performed on the effects of subcutaneous infiltration of local anaesthetics on both intra-operative hemodynamic responses and post-operative pain scores in cats. Therefore, this study was undertaken to determine if subcutaneous infiltration of lidocaine-bupivacaine mixture around the spermatic cord and skin incision is able to provide better intraoperative hemodynamic responses and improve post-operative pain scores in cats undergoing castration.

2.0 LITERATURE REVIEW

2.1 PAIN ISSUES IN CATS

In animals, pain is defined as an aversive sensory experience associated with actual or potential tissue damage. It elicits protective motor actions, results in learned avoidance and may modify species-specific traits of behavior, including social behaviour (Zimmermann, 1986). Many animal species, especially those kept as pets are treated as members of the family and pet owners demand the same level of care they expect for themselves.

According to Taylor and Robertson (2004), perioperative pain is often underestimated and under treated. This is due to the fact that they do not demonstrate overt pain-associated behaviour. Sneddon *et al*. (2014) stated that painful stimuli in humans have been shown to induce similar physiological and behavioural changes in other nonhuman mammals, including

cats. Cats tend to hide when they are sick or in pain, and it is unusual for cats to vocalize when they are in pain (Wright, 2002).

2.2 LIDOCAINE AND BUPIVACAINE

Lidocaine is a local anaesthetic of the amide type. It acts on the neuronal membrane by preventing the initiation of impulse conduction by inhibiting the ionic fluxes. The transmembrane conductance of cations such as sodium, potassium, and calcium, in both neurons and myocytes are altered. Voltage-dependent sodium channels constitute its classical targets, and the affinity of the drug for the channel is greater when it is opened (activated or inactive). Thus, the degree of blocking varies according to the neuronal stimulation frequency.

Similar to lidocaine, bupivacaine is an amide type local anaesthetic. Bupivacaine has slower rate of onset and similar in depth to that of lignocaine and mepivacaine, but is of much longer duration. In addition, they stated that bupivacaine is approximately four times as potent as lidocaine and provides a period of analgesia at least twice as long as that of lidocaine. It is exceptionally well tolerated in all tissues.

Infiltration of local anaestheticsmay potentially cause delayed healing or increased incision site reactions. In humans, adverse effects included poor wound healing and decreased ulcer healing (Brower and Johnson, 2003). There are beneficial effects of mixing lidocaine and bupivacaine. In a study on metacarpal block in sheep by Lizarraga *et al.* (2013), lidocaine-bupivacaine mixture yielded higher mechanical pressure thresholds compared to lidocaine alone. The onset of lidocaine as well as the lidocaine-bupivacaine was faster than bupivacaine alone. They have also shown that the degree of sensory block with lidocaine was less intense than that achieved with lidocaine-bupvacaine mixture or bupivacaine alone.

2.3 KETAMINE AND ACEPROMAZINE

Ketamine is a motor dissociative anaesthetic agent used in veterinary medicine. Ketamine produces its effects as a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist. The NMDA receptor is activated by the amino acid neurotransmitter glutamate, the primary excitatory neurotransmitter in the CNS. Ketamine inhibits the NMDA receptors non-competitively as ketamine binds to an ion channel receptor which is different from glutamate. Thus, it prevents the sodium and calcium ion conductance through the channel pore. The outcome to this inhibition produces both excitatory and inhibitory effects, as glutamate is instrumental in nerve signal processing at many levels in the brain and spinal cord (Mason, 2004).

Acepromazine is a member of phenothiazines, classified as neuroleptics, tranquillizers or antipsychotic agents. They are slightly different from other sedatives, where they produce a general calming effect with decreased spontaneous motor activity, while retaining sensitivity to noise. Acepromazine antagonize the neurotransmitter dopamine at subcortical excitatory dopamine D2 receptors in the basal ganglia and limbic forebrain. Acepromazine is regarded not to possess analgesic properties, but can potentiate the efficacy of other analgesics drugs (Mason, 2004). As an antagonist at alpha-1 adrenoreceptors, it may lowered blood pressures, as shown by Marroum *et al.* (1994) in horses that it decreased systolic, mean and diastolic blood pressures.

Dissociative agents are rarely used alone due to the fact that they produce a state of dysphoria in animals (Mason, 2004). Ketamine is commonly combined with a

sedative/tranquillizer to improve the anaesthetic effect. Common combinations evaluated in cats have been ketamine-xylazine and ketamine-acepromazine (Ingwersen *et al.*, 1988)

2.4 LOCAL BLOCKS IN CASTRATION PROCEDURE FOR DOGS AND CATS

Castration is a common surgical procedure performed by veterinarians. In order to carry out the procedure in a safe, effective, and cost effective analgesia and anaesthesia, a multi-modal approach should be carried out (Stevens *et al*., 2012; Moldal *et al*., 2013). One way is to incorporate local blocks in castration procedure. In a study by Stevans *et al*., (2013) lidocaine-bupivacaine mixtures administered intratesticularly in dogs did not show statistical difference in the pain scores when compared to the control group. In other studies, the intratesticular lidocaine in dogs immediately before surgery was able to reduce isoflurane requirement (McMillan *et al*., 2012). Moldal *et al.* (2013) has proven that a combination of intratesticular and subcutaneous lidocaine was able to alleviate nociceptive responses to surgery. However, it is not known if subcutaneous infiltration alone is able to alleviate intra-operative nociceptive responses and provide a lower pain scores post-operatively.

2.5 PAIN ASSESSMENT IN CATS

Diagnosis of pain can be done in two ways, which is observational or presumptive (Wright, 2002). Observational involves monitoring the activity of the cat. A painful cat may be hunched, less responsive to external stimulus, and may guard painful area (Johnson, 1991). Observation of behavior is accepted as the most accurate method for evaluating pain in dogs and cats (Epstein *et al.*, 2015). The presumptive diagnosis of a painful state is where the anticipated levels of pain have been formulated, where specific diseases or surgical techniques are classified under mild, moderate, severe, or excruciating pain (Wright, 2002).

Pain assessment in cats is generally difficult as the signs of pain can be very subtle especially in mild to moderately invasive procedures. Due to this difficulty, cats received little attention relative to their canine counterparts (Wright, 2002). She has also stated that simple observation of a cat in a cage relies upon overt expression of pain, and is often inaccurate. Pain scales have been developed that allow a semiquantitative evaluation of the degree of pain an animal may be experiencing. The UNESP-Botucatu MCPS consist of 3 domains, which are: pain expression, psychomotor change, and physiological variables. Each factor is assigned with numbers, which can results in a total score between 0 and 30 (Appendix 1). Brondani *et al.* (2013) have stated that the English version of the UNESP-Botucatu MCPS is a valid, reliable, and responsive instrument for assessing acute pain in cats undergoing ovariohysterectomy.

3.0 MATERIALS AND METHODS

3.1 ANIMALS

A total of 13 cats admitted to the Universiti Putra Malaysia Veterinary Hospital for routine castration were recruited in the study following informed owner's consent. Inclusion criteria were clinically healthy male cats of various breed, aged between 6 months to 5 years, and a body weight of 2 to 5 kg. Cats which were aggressive were excluded from the study.

3.2 PRE-SURGICAL PREPARATION

Physical examination of the cats was carried out during admission by veterinary officers. All cats were placed in individual cages in the same room. A minimum time of 16 hours was given to allow the cats to acclimatise to the environment before obtaining the basal reading for the parameters of interests by a blinded investigator (Ng Tuck Cheok). Food and water was withheld for at least 12 hours before induction of anaesthesia.

3.3 ANAESTHESIA, SKIN PREPARATION, AND SURGERY

Two cats were induced with a mixture of 10 mg/kg Ketamine (Narketan®, Vétoquinol S.A., France) and 0.1 mg/kg Acepromazine (Calmivet®, Vétoquinol S.A., France). The remaining 10 cats were induced with a mixture of 15 mg/kg Ketamine and 0.1 mg/kg Acepromazine. All 12 cats were masked and maintained on sevoflurane with oxygen flow rate of 0.5 L/min throughout the surgery using a non-rebreathing circuit. The same anaesthetic machine was used on all cats. Fur around the scrotal area was trimmed with a shaver and routine skin preparation proceeded. The castration method used was the open technique and the surgery was performed by the same surgeon for all 12 cats. At the end of the surgery, 0.2 mg/kg meloxicam (Metacam®, Boehringer Ingelheim, Germany) was given subcutaneously to all cats.

3.4 TREATMENT AND CONTROL GROUPS

The cats were randomly assigned to one of two groups, each group consist of 6 cats. The treatment group received a mixture of lidocaine (Xylocaine® 2%, AstraZeneca, Sweeden) and bupivacaine (Marcain® 0.5%, AstraZeneca, Sweeden), both at 1 mg/kg. The dosage equated to a total volume of 0.05 ml/kg lidocaine and 0.2 ml/kg bupivacaine. Half the mixture was infiltrated subcutaneously into one of the scrotal sac by introducing a 25Gx5/8" hypodermic needle at the caudal pole. The mixture was injectated as the needle was advanced cranially within the scrotal sac towards the spermatic cord. Infiltration was repeated on the other scrotal sac with the remaining mixture. The control group did not receive any injection.

3.5 OUTCOME ASSESSMENTS

Assessments were made by a single investigator blinded to the treatment received by the cats. Time points for pain scores and mechanical pressure thresholds were baseline in the

morning, before anaesthesia and surgery, followed by 2, 4, 8, and 24 hours post surgery. Intraoperative time points consisted of baseline reading (T0) at 5 minutes after local block, incision of the first scrotal skin (T1), traction and autoligation of the first spermatic cord (T2), incision of the second scrotal skin (T3), traction and autoligation of the second spermatic cord (T4).

3.5.1 INTRA-OPERATIVE DATA COLLECTION

An anaesthetic gas analyser (PROCARE Monitor B40, GE Healthcare, Germany) was used for monitoring of respiratory rate, end-tidal sevoflurane concentration, and fraction of inspired sevoflurane concentration. Pulse rate was obtained from pulse oximetry. Systolic, diastolic and mean arterial pressures were monitored via oscillometry method, using size 2 cuff at the brachium. The end-tidal sevoflurane was stabilized and maintained at 2.0% throughout the procedure. However, cats that responded to surgery with gross movement were set at a higher anaesthetic setting of 3% sevoflurane setting. The oxygen flow rate was at 0.5 L/minute. The physiological variables were taken at 5 minutes after administration of the local block for the local anaesthetic group or at 5 minutes after skin preparation for the control group, as baseline reading. Then, the physiological variables were taken at specific surgical events, described above.

3.5.2 MULTIDIMENSIONAL COMPOSITE PAIN SCALE

The cats were evaluated for pain before surgery, and at 2, 4, 8, and 24 hours post surgery using UNESP – Botucatu Multidimensional Composite Pain Scale. The plan was to administer tramadol at 5 mg/kg, SC as rescue analgesia, should any cats show pain score higher than 7 based on this pain scale (Brondani *et al.*, 2013).

3.5.3 MECHANICAL PRESSURE THRESHOLD

A custom-made pressure of palpation device as described by Basiri et al. (2013) was used to determine the amount of force applied (Appendix 2). The force resistor sensor (FSR) was placed at two sites on the cats. The primary site was at 1 cm lateral to the incision site on the perineum, while the secondary site was on the dorsal aspect of the distal metatarsus. A constant increasing force was applied until the cat reacted. The reaction was defined as vocalizing, flinch, or moving away. Three repetitive measurements were taken and the average value was obtained.

3.5.4 BLOOD PRESSURE

The blood pressures were taken at baseline, 4, 8, and 24 hours post-operative using the oscillometry method (CARESCAPE V100 Monitor, GE Healthcare, Germany). Three repetitive measurements were taken and the average value was obtained.

3.6 STATISTICAL ANALYSIS

Intra-operative and post-operative hemodynamics were normally distributed and have equal variance between groups. They were analysed using mixed ANOVA. For parameters that violate Mauchly's test of sphericity, p-values from Greenhouse-Geisser were used. Then one-way repeated measure ANOVA were done for both treatment and control groups, followed by a post-hoc Dunnett's test. Pain scores were analysed using Mann-Whitney U-test at each time points for treatment difference. Then, Friedman test was performed for both the treatment and control group, followed by post-hoc Wilcoxon signed rank test.

4.0 RESULTS

Of the 13 cats recruited, one cat was excluded from the data set as the cat underwent a different anaesthetic protocol. None of the remaining 12 cats required rescue analgesia. There were no significant difference between groups in terms of age, time from injection of sedative agent to sternal recumbency, surgery duration, anaesthesia duration, time from cessation of anaesthetic to zero end-tidal value of sevoflurane, time to righting reflex, and time to sternal recumbency (Table 1).

4.1 INTRA-OPERATIVE CARDIOPULMONARY PARAMETERS

4.1.1 MEAN, SYSTOLIC, AND DIASTOLIC ARTERIAL BLOOD PRESSURE

There was significant treatment difference in the systolic ($p= 0.009$, Figure 1), diastolic ($p= 0.018$; Figure 2), and mean arterial blood pressure ($p= 0.029$; Figure 3). Blood pressures increased with the start of surgery and peaked during traction and autoligation of the first testicle in the control group.

4.1.2 HEART RATE

Heart rates demonstrated similar changes as blood pressure($p= 0.015$; Figure 4), where the control group had a significantly higher heart rate. One-way ANOVA repeated measures revealed significant time effect in the control group ($p= 0.028$, Figure 4). Post hoc Dunnett's test showed significant difference between baseline and traction and autoligation of first testicle in the control group.

4.1.3 RESPIRATORY RATE

There was no treatment nor time effect in the respiratory rates (Figure 5).

4.2 POST-OPERATIVE RESULTS

4.2.1 PAIN SCORE

There was significant treatment difference at 4 hours post-operatively, where the local block group had lower pain scores than the control group (p= 0.002; Figure 6). Significant difference was not detected at 8 (p= 0.059; Figure 6) and 24 hours (p= 0.902; Figure 6) post-operatively. Within the control group, pain scores at 4 and 8 hours were higher than baseline. Pain scores were not different over time in the local anaesthetic group (p= 0.801, Figure 6)

4.2.2 MECHANICAL PRESSURE THRESHOLD (MPT) VALUES

Statistical analysis for the MPT values at the perineum (Figure 7) showed no significant treatment difference (p=0.141). There is significant time (p=0.006) and treatment-time interaction (p= 0.029). The local anaesthetic group showed lower perineal MPT values at 2, 4, 8 and 24 hours post-operatively when compared to the baseline. In the control group, significant time effect could not be demonstrated (p=0.099)

There were no treatment (p=0.232), time (p=0.401) nor treatment-time interaction(p=0.368) effect on the MPT values at the metatarsus (Figure 8). Within the local anaesthetic group, post-operative metatarsal MPT values were not different from baseline. In the control group, metatarsal MPT values at 2 and 4 hours post-operatively were lower than baseline.

4.2.3 PHYSIOLOGICAL PARAMETERS

The systolic, diastolic, and mean arterial blood pressure, heart rate, and respiratory rate (Graph shown at Figure 9, Figure 10, Figure 11, Figure 12, and Figure 13) showed no significant difference in terms of treatment, time, and treatment-time interaction.

	Group A (Local Anaesthetic Group)	Group B (Control Group)	p-values
No. of Animal	6	6	
Age (months ± SD)	15.83 (±15.96)	15.00 (±16.33)	0.931
Time to Induce (sec ± SD)	228.33 (±80.23)	200.50 (±55.64)	0.501
Surgery Duration (min ± SD)	5.33 (±2.25)	4.00 (±1.41)	0.247
Anaesthesia Duration (min ± SD)	25.67 (±4.63)	22.33 (±4.89)	0.253
Time to righting reflex (min ± SD)	27.00 (± 11.31)	32.33 (±18.12)	0.554
Time to sternal (min ± SD)	39.83 (±16.85)	46.83 (±21.18)	0.541
Time to zero Et (min ± SD)	3.17 (±1.94)	2.33 (±1.86)	0.465

Table 1: Age, time to induce, surgery duration, anaesthesia duration, time to righting reflex, time to sternal, and time to zero end-tidal value of sevoflurane for both treatment and control group.

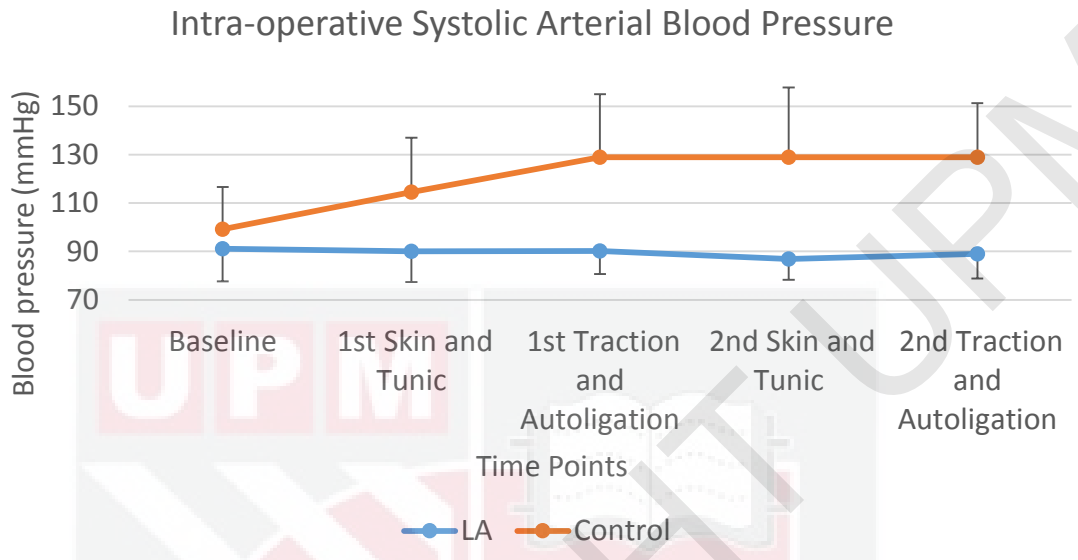

Figure 1: Intra-operative systolic arterial blood pressures. Values expressed as mean ± SD. There is significant time (p= 0.021) and time-treatment interaction (p= 0.009).

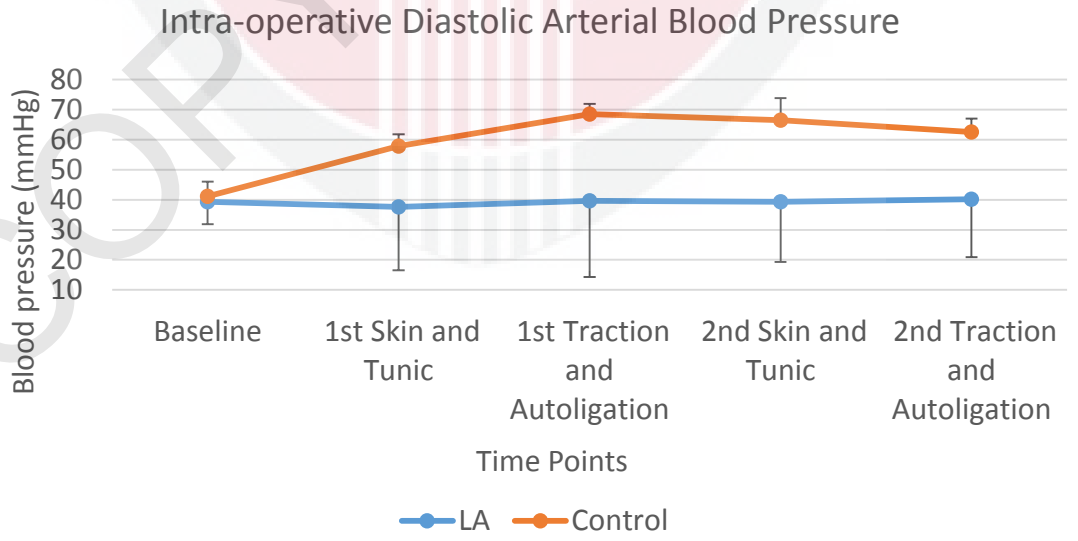

Figure 2: Intra-operative diastolic arterial blood pressures. Values expressed as mean ± SD. There is significant treatment difference (p= 0.018).

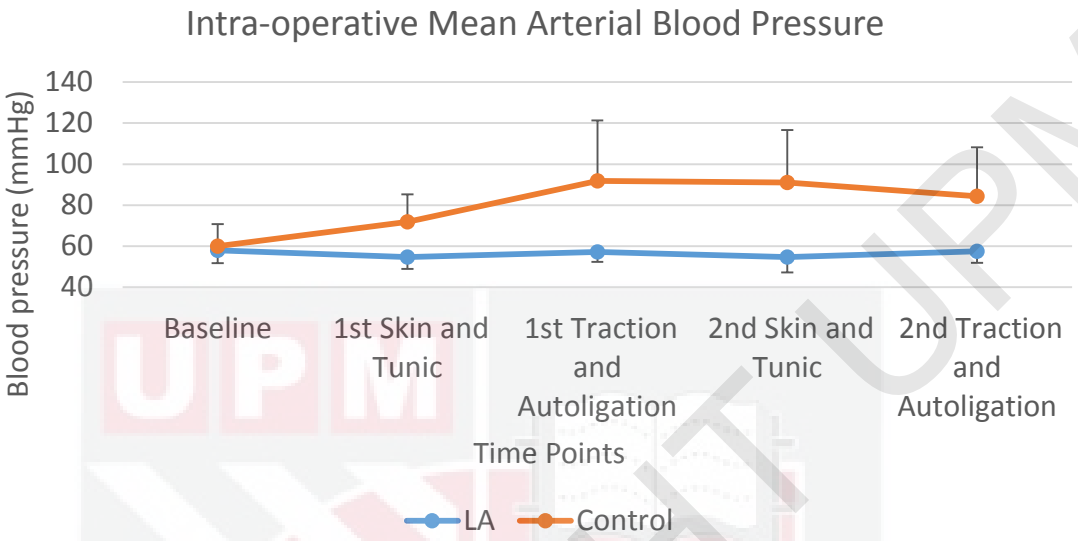

Figure 3: Intra-operative mean arterial blood pressures. Values expressed as mean ± SD. There is significant treatment difference (p= 0.029).

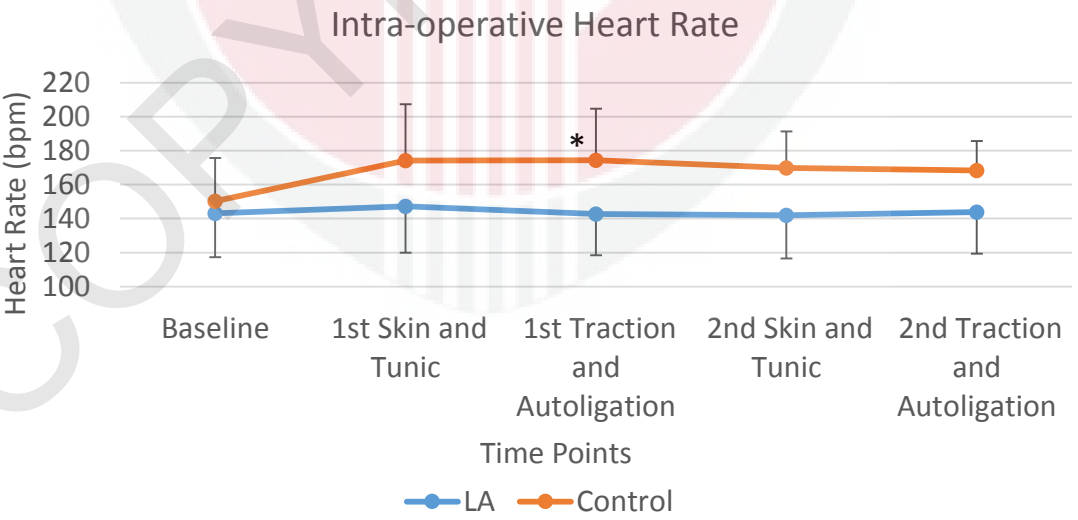

Figure 4: Intra-operative heart rates. Values expressed as mean ± SD. There is significant treatment difference (p= 0.015)

* Within treatment group, significant heart rate difference from baseline.

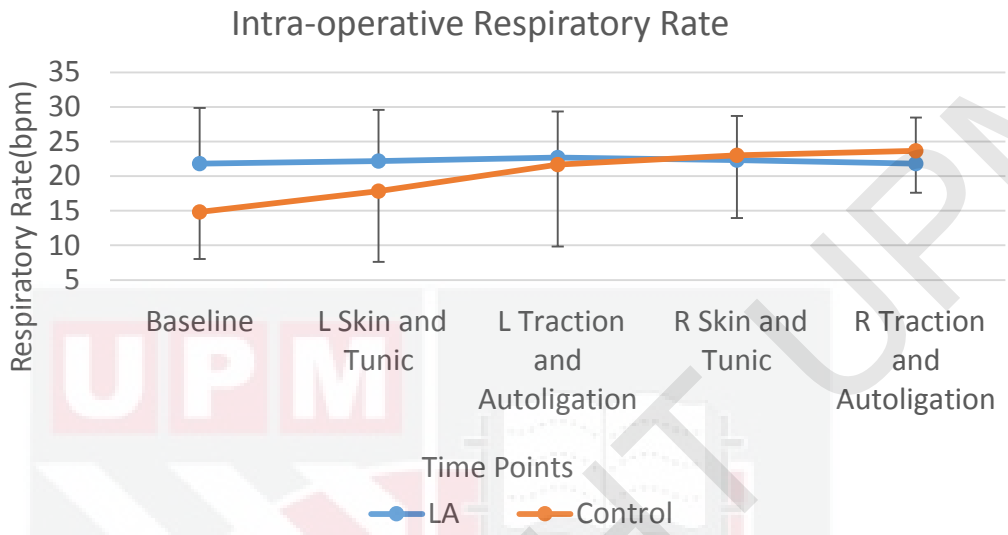

Figure 5: Intra-operative respiratory rates. Values expressed as mean ± SD.

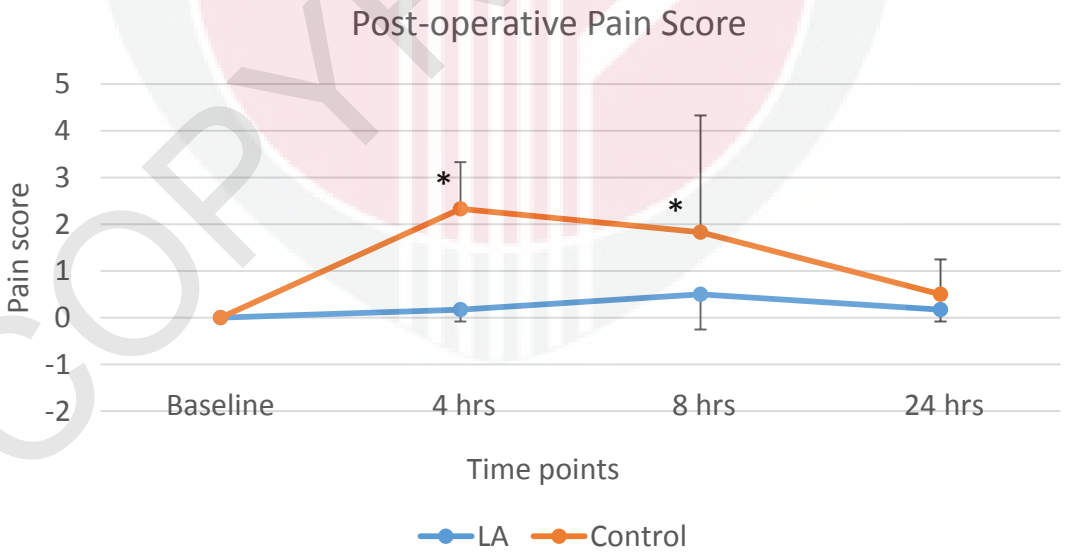

Figure 6: Post-operative pain scores. Values expressed as mean ± IQR. At 4 hours, there is significant difference (p= 0.002) between the local anaesthetic and control group in terms of the pain score

* Within treatment group, significant pain score difference from baseline

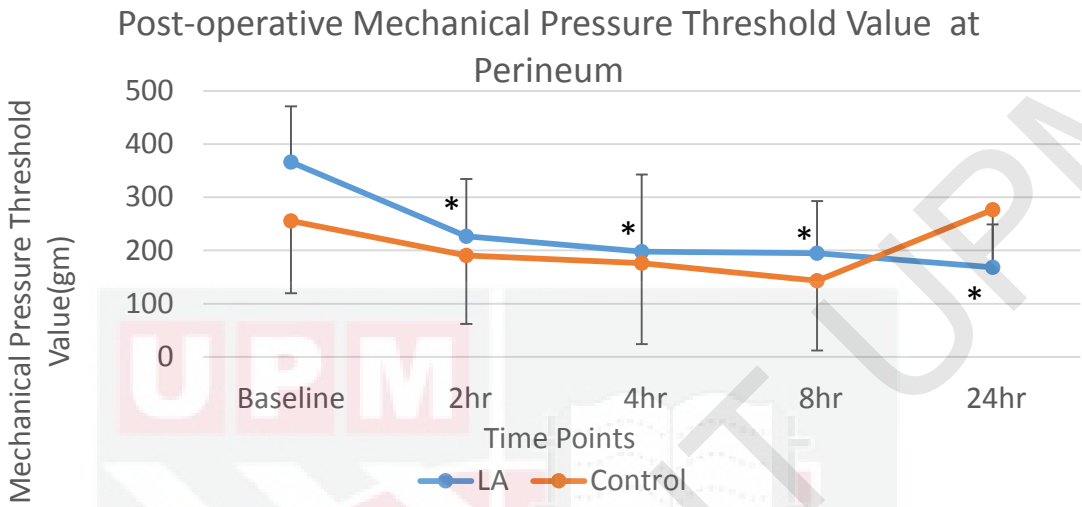

Figure 7: Post-operative mechanical pressure threshold values at perineum. Values expressed as mean ± SD. There is significant time (p= 0.006) and treatment-time interaction (p= 0.029)

* Within treatment group, significant MPT value difference when compared to baseline

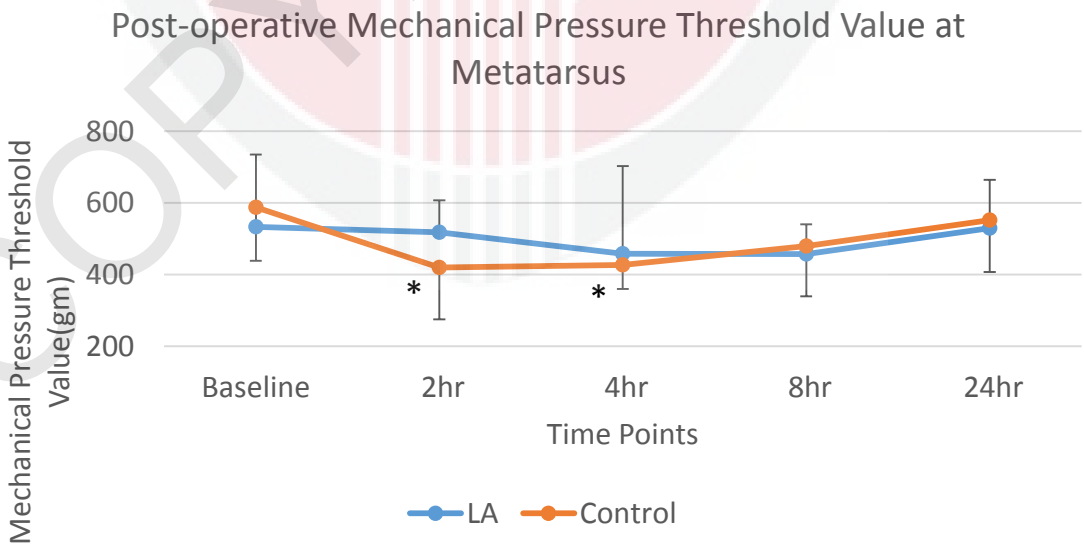

Figure 8: Post-operative mechanical pressure threshold values at metatarsus. Values expressed as mean ± SD.

* Within treatment group, significant MPT value difference when compared to baseline

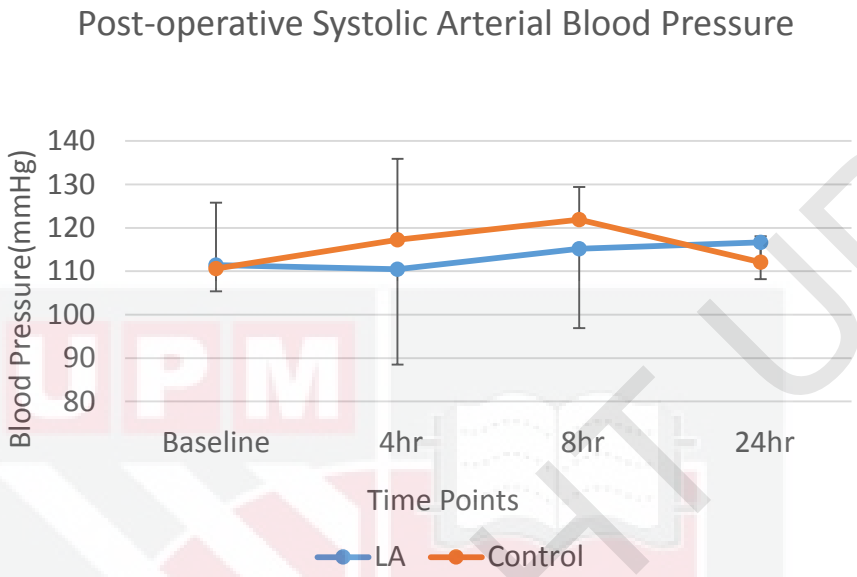

Figure 9: Post-operative systolic arterial blood pressures. Values expressed as mean ± SD.

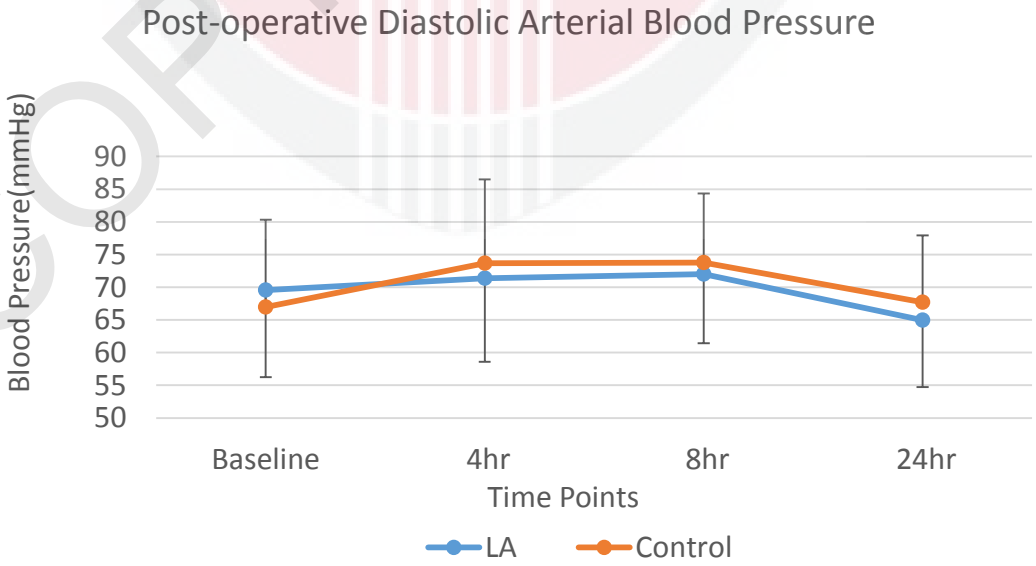

Figure 10: Post-operative diastolic arterial blood pressures. Values expressed as mean ± SD.

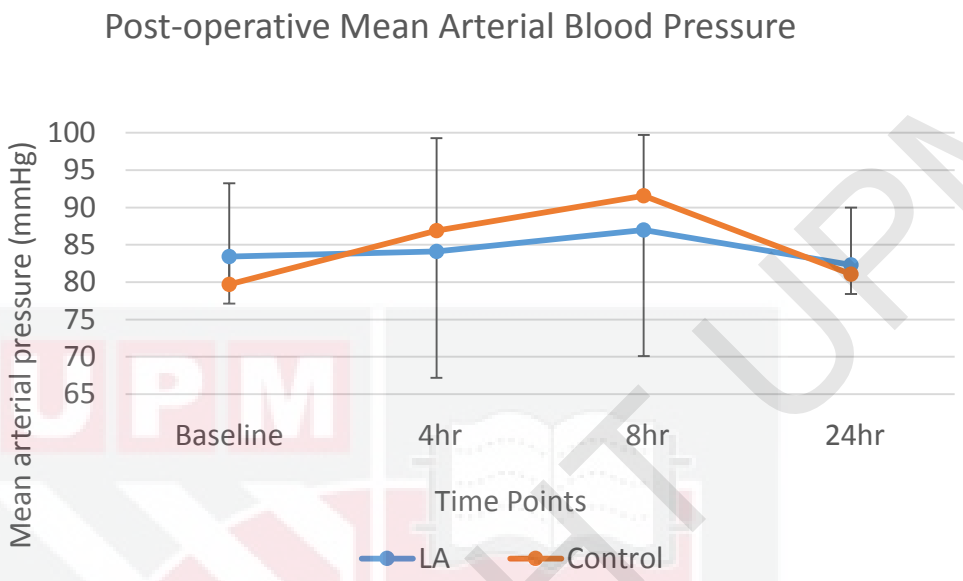

Figure 11: Post-operative mean arterial blood pressures. Values expressed as mean ± SD.

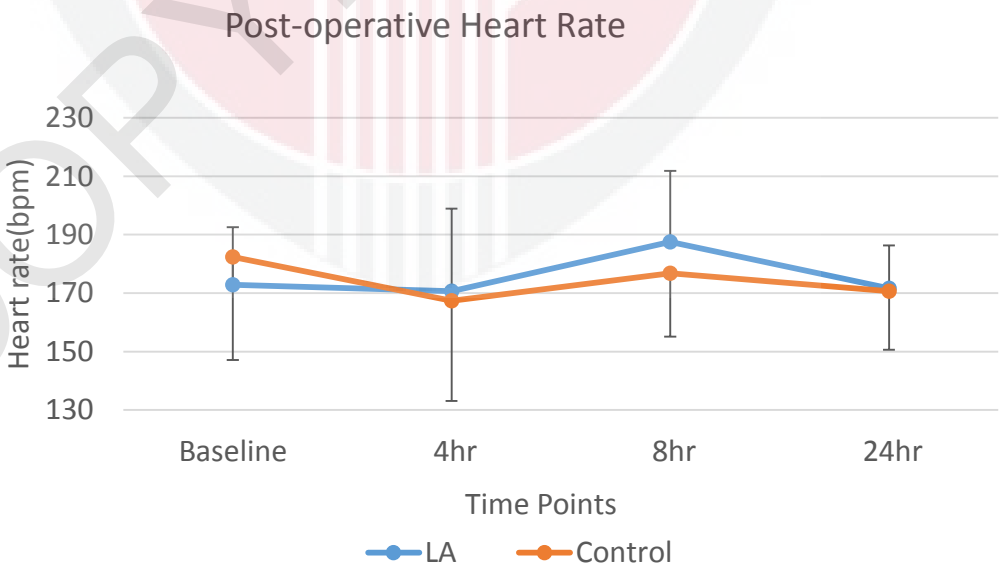

Figure 12: Post-operative heart rates. Values expressed as mean ± SD.

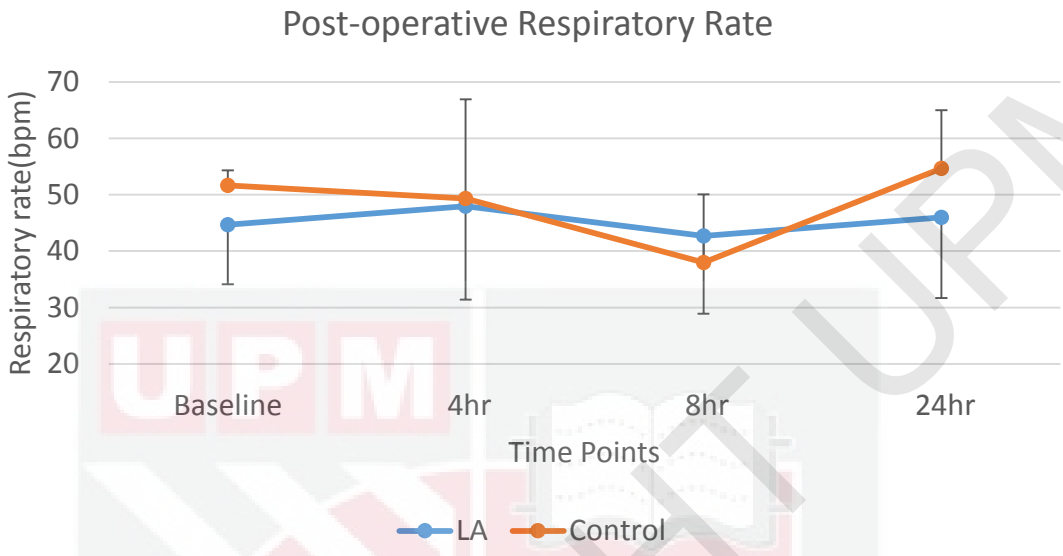

Figure 13: Post-operative respiratory rates. Values expressed as mean ± SD.

5.0 DISCUSSION

This study was designed to demonstrate the benefit of adding lidocaine-bupivacaine block in cats undergoing castration. This surgery induced significant hemodynamic responses such as the blood pressure and heart rate. This study clearly demonstrated that local blocks with lidocaine-bupivacaine obtunded the intra-operative hemodynamic responses and this finding concurred with the study by Moldal *et al.* (2013). Further, the mixture provided additional analgesic benefit, evidenced by lower pain scores at 4 hours post castration.

Intra-operatively, the control group has a higher heart rates and blood pressures. This is because the intra-operative nociception, such as skin incision and manipulation of the testicles stimulated the sympatho-adrenal system, thus causing the increase in the hemodynamic responses. The hemodynamics peaked at the traction and autoligation of the first spermatic cord, probably indicating that as the most noxious stimuli. In the treatment

group, the administration of the local block prior to surgery obtunded the responses, resulting in stable hemodynamics. This indicated that the subcutaneous infiltration of the lidocaine-bupivacaine mixture into the scrotal sac and around the spermatic cord was able to exert anaesthetic effect throughout the surgery. This result concurred with previous studies in cats and dogs, where the local anaesthetics were administered intratesticularly (Moldal *et al.*, 2013; McMillan *et al.*, 2012). This stability that was produced during surgery is an advantage as the anaesthetic agent used may be reduced. This information corresponds with the study done by Zilberstein *et al.* (2008) where he has proven that supplementing a general anaesthetic protocol by the addition of local block has significant analgesic benefits and less supplemental anaesthetic is required. Nevertheless, it may be difficult to show additional benefit of adding local block prior to castration, as the existing anaesthetic and analgesic protocol used might have been sufficient to manage pain related to castration (Shih, 2008).

Post-operatively, pain scores at 4 hours were lower in the local block group, but the mechanical pressure threshold (MPT) values at the perineum and metatarsus showed no treatment difference. Furthermore, post-operative perineal MPT values in the local block group was found to be lower at all time points when compared to the baseline. This result of perineal MPT do not correlate with the obtundation of intra-operative hemodynamic responses and lower pain scores at 4 hours in local block group. At closer examination, however, the baseline perineal MPT values were higher in the local block compared to the control group. This may have caused steeper decrement of post-operative perineal MPT, therefore, resulting in detection of statistical significance in the local block group. Furthermore, the high variation in the MPT values may suggest that the methodology of determining MPT in this study need further refinement.

Results from this study seems to suggest that the UNESP-Botucatu multidimensional composite pain scale was better in differentiating group treated with local block or not. The pain scale used in this study assess the degree of based on 3 subscales, which are the pain expression, psychomotor change, and physiological variables. Taylor and Robertson (2004) stated that behavioral methods are the best method of assessing pain. By looking at different aspects to detect pain, the sensitivity of the pain scale can be increased. The UNESP-Botucatu pain scale has been used by Brondani *et al.* (2013) to assess pain in cats following OHE, and has been proven to be valid and reliable.

The physiological parameters post-operatively did not show any significant difference between the treatment and control group. This is because physiological parameters such as respiratory rates, heart rates, and blood pressures can be affected by other physiological changes, such as stress. Similar studies have shown that the heart rates and respiratory rates may not be different between animals that have underwent surgery with those what did not (Wright, 2002). Many other physiologic changes and pharmacologic manipulations can alter these parameters, making them non-specific and inaccurate indices of pain.

6.0 CONCLUSION

In conclusion, this study have shown the beneficial effects of lidocaine-bupivacaine block on cats undergoing castration. This study demonstrated that the local block was able to produce lower and more stable intra-operative hemodynamic responses. It also significantly reduce early post-operative pain scores. Therefore, this local block procedure should be considered to augment analgesia in cats undergoing castration.

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APPENDICES

Appendix 1: UNESP-Botucatu Multidimensional Composite Pain Scale

UNESP-Botucatu Multidimensional Composite Pain Scale for assessing postoperative pain in cats.

Subscale 1: PAIN EXPRESSION (0 – 12)		
Miscellaneous behaviors	Observe and mark the presence of the behaviors listed below	
	A - The cat is laying down and quiet, but moving its tail	A
	B - The cat contracts and extends its pelvic limbs and/or contracts its abdominal muscles (flank)	B
	C - The cats eyes are partially closed (eyes half closed)	C
	D - The cat licks and/or bites the surgical wound	D
	• All above behaviors are absent	0
	• Presence of one of the above behaviors	1
	• Presence of two of the above behaviors	2
	• Presence of three or all of the above behaviors	3
Reaction to palpation of the surgical wound	• The cat does not react when the surgical wound is touched or pressed; or no change from pre-surgical response (if basal evaluation was made)	0
	• The cat does not react when the surgical wound is touched, but does react when it is pressed. It may vocalize and/or try to bite	1
	• The cat reacts when the surgical wound is touched and when pressed. It may vocalize and/or try to bite	2
	• The cat reacts when the observer approaches the surgical wound. It may vocalize and/or try to bite The cat does not allow palpation of the surgical wound	3
Reaction to palpation of the abdomen/flank	• The cat does not react when the abdomen/flank is touched or pressed; or no change from pre-surgical response (if basal evaluation was made). The abdomen/flank is not tense	0
	• The cat does not react when the abdomen/flank is touched, but does react when it is pressed. The abdomen/flank is tense	1
	• The cat reacts when the abdomen/flank is touched and when pressed. The abdomen/flank is tense	2
	• The cat reacts when the observer approaches the abdomen/flank. It may vocalize and/or try to bite The cat does not allow palpation of the abdomen/flank	3
Vocalization	• The cat is quiet, purring when stimulated, or miaows interacting with the observer, but does not growl, groan, or hiss	0
	• The cat purrs spontaneously (without being stimulated or handled by the observer)	1
	• The cat growls, howls, or hisses when handled by the observer (when its body position is changed by the observer)	2
	• The cat growls, howls, hisses spontaneously (without being stimulated or handled by the observer)	3

Subscale 2: PSYCHOMOTOR CHANGE (0 – 12)		
Posture	• The cat is in a natural posture with relaxed muscles (it moves normally)	0
	• The cat is in a natural posture but is tense (it moves little or is reluctant to move)	1
	• The cat is sitting or in sternal recumbency with its back arched and head down; or The cat is in dorso-lateral recumbency with its pelvic limbs extended or contracted	2
	• The cat frequently alters its body position in an attempt to find a comfortable posture	3
Comfort	• The cat is comfortable, awake or asleep, and interacts when stimulated (it interacts with the observer and/or is interested in its surroundings)	0
	• The cat is quiet and slightly receptive when stimulated (it interacts little with the observer and/or is not very interested in its surroundings)	1
	• The cat is quiet and "dissociated from the environment" (even when stimulated it does not interact with the observer and/or has no interest in its surroundings) The cat may be facing the back of the cage	2
	• The cat is uncomfortable, restless (frequently changes its body position), and slightly receptive when stimulated or "dissociated from the environment" The cat may be facing the back of the cage	3
Activity	• The cat moves normally (it immediately moves when the cage is opened; outside the cage it moves spontaneously when stimulated or handled)	0
	• The cat moves more than normal (inside the cage it moves continuously from side to side)	1
	• The cat is quieter than normal (it may hesitate to leave the cage and if removed from the cage tends to return, outside the cage it moves a little after stimulation or handling)	2
	• The cat is reluctant to move (it may hesitate to leave the cage and if removed from the cage tends to return, outside the cage it does not move even when stimulated or handled)	3
Attitude	Observe and mark the presence of the mental states listed below	
	A - Satisfied: The cat is alert and interested in its surroundings (explores its surroundings), friendly and interactive with the observer (plays and/or responds to stimuli) *The cat may initially interact with the observer through games to distract it from the pain. Carefully observe to distinguish between distraction and satisfaction games	A
	B - Uninterested: The cat does not interact with the observer (not interested by toys or plays a little; does not respond to calls or strokes from the observer) * In cats which don't like to play, evaluate interaction with the observer by its response to calls and strokes	B
	C - Indifferent: The cat is not interested in its surroundings (it is not curious; it does not explore its surroundings) * The cat can initially be afraid to explore its surroundings. The observer needs to handle the cat and encourage it to move itself (take it out of the cage and/or change its body position)	C
	D - Anxious: The cat is frightened (it tries to hide or escape) or nervous (demonstrating impatience and growling, howling, or hissing when stroked and/or handled)	D
	E - Aggressive: The cat is aggressive (tries to bite or scratch when stroked or handled)	E
	• Presence of the mental state A	0
	• Presence of one of the mental states B, C, D, or E	1
	• Presence of two of the mental states B, C, D, or E	2
	• Presence of three or all of the mental states B, C, D, or E	3

Subscale 3: PHYSIOLOGICAL VARIABLES (0 – 6)		
Arterial blood pressure	• 0% to 15% above pre-surgery value	0
	• 16% to 29% above pre-surgery value	1
	• 30% to 45% above pre-surgery value	2
	• > 45% above pre-surgery value	3
Appetite	• The cat is eating normally	0
	• The cat is eating more than normal	1
	• The cat is eating less than normal	2
	• The cat is not interested in food	3
TOTAL SCORE (0 – 30)		

Directions for using the scale

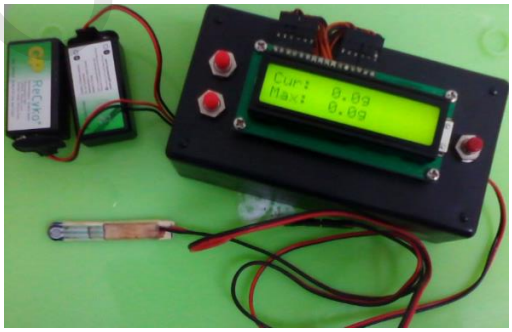
Initially observe the cat's behavior without opening the cage. Observe whether it is resting or active; interested or uninterested in its surroundings; quiet or vocal. Check for the presence of specific behaviors (see "Miscellaneous behaviors" above).

Open the cage and observe whether the cat quickly moves out or hesitates to leave the cage. Approach the cat and evaluate its reaction: friendly, aggressive, frightened, indifferent, or vocal. Touch the cat and interact with it, check whether it is receptive (if it likes to be stroked and/or is interested in playing). If the cat hesitates to leave the cage, encourage it to move through stimuli (call it by name and stroke it) and handling (change its body position and/or take it out of the cage). Observe when outside the cage, if the cat moves spontaneously, in a reserved manner, or is reluctant to move. Offer it palatable food and observe its response.*

Finally, place the cat in lateral or sternal recumbency and measure its arterial blood pressure. Evaluate the cat's reaction when the abdomen/flank is initially touched (slide your fingers over the area) and in the sequence gently pressed (apply direct pressure over the area). Wait for a time, and do the same procedure to assess the cat's reaction to palpation of surgical wound.

*To evaluate appetite during the immediate postoperative period, initially offer a small quantity of palatable food immediately after recovery from anesthesia. At this moment most cats eat normally independent of the presence or absence of pain. Wait a short while, offer food again, and observe the cat's reaction.

Appendix 2: Mechanical pressure threshold device



Appendix 3:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	1
CASE NO.	58027
CAGE NO.	96
CAT ID	tarzan

AGE	7 m.o.
BODY WEIGHT	3.6
BREED	DSH
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30								
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	2 1st	2 2nd	2 3rd	2 Ave
8pm (pre)									Appetite*: not eating much			Rxn to palpation**: allow				Activity:cautious											
8am (pre)	96	53	68				212	56	Appetite*:not eating much			Rxn to palpation**allow				Activity: cautious				255	117	97		535	651	486	
	105	40	58																								
	92	40	54																								
1 hour									0	0	0	0	1	0	0	0	0	0	0								
2 hours									0	0	0	0	1	0	0	0	0	0	0	22	29	19		438	251	352	
4 hours	91	65	74				188	28	0	0	0	0	1	0	0	0	1	0	2	21	65	43		500	499	371	
	90	70	76																								
6 hours									0	0	0	0	0	0	0	0	0	0	0								
8 hours	137	86	105				152	32	0	0	0	0	0	0	0	0	0	0	0	135	115	175		360	513	410	
	104	57	75																								
24 hours	93	68	73				180	48	0	0	0	0	0	0	0	0	0	1	1	65	118	62		509	650	486	
	131	76	97																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	10.00am	10.05am

SURGERY START/END	10.32am
ANAESTHESIA OFF TIME	10.38am
ANAESTHESIA DURATION	10.07am
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.42am
STERNAL RECUMBENCY TIME	10.48am

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	10.26	116	51	74	104	180	22	2.9/2.9		0.50%	2.50%	
T1(L skin and tunic)	10.27	138	73	96	118	224	36	2.9/2.9		0.5	2.5	
T2(L Traction and auto)	10.29	144	82	103	140	220	44	2.9/2.9		0.5	2.5	
T3(R skin and tunic)	10.31	144	71	100	124	200	44	3.4/3.4		0.5	4	
T4(R Traction and auto)	10.32	124	64	89	130	188	35	3.4/3.4		0.5	4	

Appendix 4:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	2
CASE NO.	56829
CAGE NO.	97
CAT ID	tumi

AGE	10m.o.
BODY WEIGHT	3.6
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score										Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables				1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *	Total/30	1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*: did not eat			Rxn to palpation**: good					Activity: alert										
8am (pre)	98	61	71				188	48	Appetite*: did not eat			Rxn to palpation**: uncomfortable					Activity: alert			313	329	571		498	658	779	
	122	62	83																									
1 hour									0	0	0	0	0	1	0	0	0	0	1								
2 hours									0	0	0	0	0	1	0	0	0	0	1	112	74	239		236	576	811	
4 hours	101	74	84				196	40	0	0	0	0	0	0	0	0	0	0	0	172	105	140		571	760	859	
	100	57	73																									
	92	62	73																									
6 hours									0	0	0	0	0	0	2	0	0	0	2								
8 hours	86	66	72				220	28	0	0	0	0	0	0	0	0	0	0	0	264	247	102		575	474	582	
	88	67	74																									
	130	91	107																									
24 hours	119	76	93				200	32	0	0	0	0	0	0	0	0	1	0	1	55	43	127		412	570	747	
	143	60	86																									

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.14:10	9.21:50

SURGERY START/END	9.43
ANAESTHESIA OFF TIME	9.51
ANAESTHESIA DURATION	9.24
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	9.58
STERNAL RECUMBENCY TIME	10.03

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	9.4	116	48	69	104	188	8	1.4/1.4		0.5	3	
T1(L skin and tunic)	9.43	96	39	57	100	192	10	3.0/3.0		0.5	3	
T2(L Traction and auto)	9.44	96	42	61	90	180	12	3.0/3.0		0.5	3	
T3(R skin and tunic)	9.47	95	40	58	92	180	13	3.0/3.0		0.5	3	
T4(Rtraction and autoligation)	9.5	90	43	61	100	180	12	3.0/3.0		0.5	3	

Appendix 5:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	3
CASE NO.	61513
CAGE NO.	96
CAT ID	putih

AGE	1 y.o
BODY WEIGHT	3.1
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30	1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*: did not touch food				Rxn to palpation**: allow				Activity: cautious											
8am (pre)	91	59	71				176	48	Appetite*:				Rxn to palpation**: allow				Activity: cautious			233	329	404		379	279	242	
	129	64	86																								
	119	61	80																								
1 hour									0	0	0	0	0	0	0	0	0	0	0								
2 hours									0	0	0	0	0	1	0	0	0	0	1	342	179	265		546	654	332	
4 hours	91	48	66				144	32	0	0	0	0	0	0	0	0	0	0	0	312	276	197		412	611	577	
	93	70	76																								
	86	68	73																								
6 hours									0	0	0	0	0	0	2	0	0	0	2								
8 hours	141	91	112				156	52	0	0	0	0	0	0	0	0	0	0	0	68	166	154		680	484	284	
	137	102	115																								
	140	113	123																								
24 hours	91	52	64				164	56	0	0	0	0	0	0	0	0	0	0	0	70	103	127		696	370	646	
	130	68	86																								
	116	80	89																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.19:45	9.24:30

SURGERY START/END	9.45/9.54
ANAESTHESIA OFF TIME	9.54
ANAESTHESIA DURATION	33
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.28
STERNAL RECUMBENCY TIME	10.46

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	9.45	93	35	59	96	148	28	2.2/2.2	32/6	0.5	2	
T1(L skin and tunic)	9.46	107	42	61	96	147	26	2.2/2.2	32/6	0.5	2	
T2(L Traction and auto)	9.47	98	42	60	98	145	27	2.2/2.2	32/6	0.5	2	
T3(R skin and tunic)	9.5	83	37	53	100	142	26	2.2/2.2	32/6	0.5	2	
T4(Rtraction and autoligation)	9.51	92	37	54	98	146	26	2.1/2.2	32/5	0.5	2	

Appendix 6:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	4
CASE NO.	60542
CAGE NO.	97
CAT ID	Chechek

AGE	10 m.o.
BODY WEIGHT	3.9
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30	1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*: good				Rxn to palpation**:allow				Activityalert											
8am (pre)	82	62	68				167	50	Appetite*:				Rxn to palpation**:allow				Activityalert			190	211	121		374	592	353	
	124	79	96																								
	135	77	99																								
1 hour									0	0	0	0	0	0	0	0	0	0	0								
2 hours									0	0	0	0	0	0	1	0	0	0	1	187	188	211		520	326	554	
4 hours	119	56	73				140	64	0	0	0	0	0	0	2	0	0	0	2	193	152	289		476	511	356	
	144	93	110																								
	124	72	86																								
6 hours									0	0	0	0	0	0	2	0	0	0	2								
8 hours	95	73	80				162	28	0	0	0	0	0	0	0	0	0	0	0	76	241	242		443	243	288	
	103	77	85																								
	133	79	101																								
24 hours	91	74	77				137	64	0	0	0	0	0	0	0	0	0	0	0	523	460	279		659	295	252	
	137	77	92																								
	131	82	96																								

Induction Agent	Time Given	Time to lateral
Ketamine-acepromazine	10.01:55	10.04:48

SURGERY START/END	10.25/10.29
ANAESTHESIA OFF TIME	10.3
ANAESTHESIA DURATION	25
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	11.25
STERNAL RECUMBENCY TIME	11.31

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	10.25	89	36	52	82	162	15	2.0/2.2	17/1	0.5	2	
T1(L skin and tunic)	10.25	133	62	86	96	172	19	1.9/2.1	31/11	0.5	2	
T2(L Traction and auto)	10.28	156	96	130	152	171	24	1.9/2.2	36/11	0.5	2	
T3(R skin and tunic)	10.28	157	95	126	160	180	22	2.0/2.2	34/14	0.5	2	
T4(R traction and autoligation)	10.29	157	95	125	162	174	23	2.0/2.2	36/12	0.5	2	

Appendix 7:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	5
CASE NO.	59028
CAGE NO.	97
CAT ID	bubu

AGE	6 m.o.
BODY WEIGHT	3.2
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30	1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*:did not eat				Rxn to palpation**:good				Activityalert											
8am (pre)	97	63	75				168	44	Appetite*:				Rxn to palpation**:good				Activityalert			170	189	276		220	261	310	
	120	92	102																								
1 hour									0	0	0	0	1	1	1	0	0	0	3								
2 hours									1	0	0	0	0	0	0	0	0	0	1	75	133	85		232	659	522	
4 hours	132	85	100				196	68	0	0	0	0	0	0	0	0	0	0	0	78	107	21		238	288	151	
	117	83	94																								
	142	91	111																								
6 hours									0	0	0	0	0	0	0	0	0	0	0								
8 hours	94	61	73				212	60	0	0	0	0	0	0	0	0	0	0	0	160	260	103		349	316	395	
	88	53	60																								
24 hours	98	65	77				173	58	0	0	0	0	0	0	0	0	0	0	0	193	293	162		251	223	312	
	106	71	81																								
	117	62	82																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.53:25	9.55:30

SURGERY START/END	10.18/10.22
ANAESTHESIA OFF TIME	10.23
ANAESTHESIA DURATION	23
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.4
STERNAL RECUMBENCY TIME	10.47

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	10.18	91	42	60	92	141	29	2.0/2.0	30	0.5	2	
T1(L skin and tunic)	10.19	100	42	61	94	149	28	2.0/2.0	31	0.5	2	
T2(L Traction and auto)	10.2	100	43	62	90	140	28	2.0/2.0	31	0.5	2	
T3(R skin and tunic)	10.21	91	39	57	92	139	27	2.0/2.0	31	0.5	2	
T4(R traction and autoligation)	10.22	99	39	57	90	141	26	1.9/2.0	31	0.5	2	

Appendix 8:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	6
CASE NO.	61571
CAGE NO.	96
CAT ID	zorro

AGE	6 m.o.
BODY WEIGHT	3
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30					2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*:good				Rxn to palpation**:allow				Activity:alert											
8am (pre)	96	59	67				200	52	Appetite*:				Rxn to palpation**:allow				Activity:alert			399	582	373		963	587	545	
	114	79	91																								
1 hour									0	0	0	0	1	1	1	0	0	0	3								
2 hours									0	0	0	0	0	0	0	0	0	0	0	190	303	461		381	395	429	
4 hours	96	68	77				180	48	0	0	0	0	0	0	0	0	0	0	0	19	117	21		722	664	659	
	106	47	63																								
	111	45	65																								
6 hours									0	0	0	0	0	0	0	0	0	2	2								
8 hours	123	63	84				172	28	0	0	0	0	0	0	0	0	0	0	0	254	206	115		432	663	221	
	100	47	63																								
	108	72	86																								
24 hours	102	76	86				160	54	0	0	0	0	0	0	0	0	0	0	0	121	313	33		515	380	714	
	141	81	103																								
	93	40	54																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.14:37	9.16:47

SURGERY START/END	9.40/9.46
ANAESTHESIA OFF TIME	9.46
ANAESTHESIA DURATION	26
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.2
STERNAL RECUMBENCY TIME	10.3

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	9.4	81	37	53	84	126	21	2.0/2.0	25	0.5	2	
T1(L skin and tunic	9.41	80	33	48	86	127	20	2.0/2.0	26	0.5	2	
T2(L Traction and auto)	9.42	84	37	53	84	126	20	1.9/2.0	27	0.5	2	
T3(R skin and tunic)	9.44	84	35	50	88	125	19	1.9/2.0	28	0.5	2	
T4(R traction and autoligation)	9.45	87	38	55	88	125	19	1.9/2.0	29	0.5	2	

Appendix 9:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	7
CASE NO.	59905
CAGE NO.	97
CAT ID	black

AGE	1 y.o
BODY WEIGHT	3.8
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
									Pain Expression				Psychomotor Change				Physio Variables								2			
	Oscill.			Dopler					Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *	Total/30	1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*:good				Rxn to palpation**: allow				Activity:alert											
8am (pre)	90	66	74				155	48	Appetite*:				Rxn to palpation**:allow				Activity:alert			175	345	177		605	567	469	
	103	48	68																								
1 hour									0	0	0	0	0	0	0	0	0	0	0								
2 hours									0	0	0	0	1	0	1	0	0	0	2	265	193	147		466	695	336	
4 hours	81	51	60				212	50	0	0	0	0	1	0	2	0	0	0	3	39	293	188		392	622	288	
	151	65	93																								
	126	52	74																								
6 hours									0	0	0	0	1	0	2	0	0	0	3								
8 hours	116	69	87				189	24	0	0	0	0	0	0	0	0	2	0	2	83	18	62		197	273	424	
	120	81	96																								
	139	87	96																								
24 hours	96	61	74				176	68	0	0	0	0	0	0	0	0	0	0	0	320	231	194		541	643	425	
	107	51	68																								
	104	60	76																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.49:30	9.53:05

SURGERY START/END	10.12/10.14
ANAESTHESIA OFF TIME	10.14
ANAESTHESIA DURATION	19
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.35
STERNAL RECUMBENCY TIME	10.45

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	10.11	72	31	45	92	144	18	2.0/2.0	40	0.5	2	
T1(L skin and tunic)	10.12	84	37	53	112	165	18	1.9/2.0	41	0.5	2	
T2(L Traction and auto)	10.12	112	48	69	126	178	20	1.9/2.0	40	0.5	2	
T3(R skin and tunic)	10.13	106	66	81	126	174	21	1.9/2.0	42	0.5	2	
T4(R traction and autoligation)	10.14	108	63	78	122	180	21	1.9/2.0	42	0.5	2	

Appendix 10:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	8
CASE NO.	61557
CAGE NO.	:
CAT ID	gentle giant

AGE	4 y.o
BODY WEIGHT	4.6
BREED	dsh
TEMPERAMENT	very good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
									Pain Expression				Psychomotor Change				Physio Variables								2			
	Oscill.			Dopler					Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *	Total/30	1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*:good				Rxn to palpation**:allow				Activity:alert											
8am (pre)	105	68	76				145	24	Appetite*:				Rxn to palpation**:allow				Activity:alert			264	405	266		627	504	571	
	114	77	92																								
1 hour									0	0	0	0	0	0	0	0	0	0	0								
2 hours									0	0	0	0	1	0	0	0	0	0	1	132	144	229		541	512	490	
4 hours	98	80	86				180	32	0	0	0	0	0	0	0	0	0	0	0	159	157	54		243	174	164	
	90	61	71																								
	99	61	75																								
6 hours									0	0	0	0	0	0	0	0	0	0	0								
8 hours	119	81	95				185	36	0	0	0	0	0	0	0	0	0	0	0	139	63	111		579	168	370	
	131	92	106																								
	146	54	78																								
24 hours	83	48	57				171	24	0	0	0	0	0	0	0	0	0	0	0	262	109	125		674	447	767	
	119	73	91																								
	161	77	104																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.05:00	9.09:45

SURGERY START/END	9.34/9.41
ANAESTHESIA OFF TIME	9.41
ANAESTHESIA DURATION	26
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.14
STERNAL RECUMBENCY TIME	10.35

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	9.33	89	38	54	92	112	21	2.0/2.2	30	0.5	2	
T1(L skin and tunic)	9.34	78	34	49	93	112	19	2.1/2.2	30	0.5	2	
T2(L Traction and auto)	9.35	79	38	50	96	118	21	2.1/2.1	40	0.5	2	
T3(R skin and tunic)	9.4	73	32	44	96	107	19	2.1/2.1	33	0.5	2	
T4(R traction and autoligation)	9.41	70	33	48	92	112	18	2.0/2.1	42	0.5	2	

Appendix 11:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	9
CASE NO.	61629
CAGE NO.	95
CAT ID	orange

AGE	4 m.o.
BODY WEIGHT	2.4
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30	1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*: good				Rxn to palpation**:allow				Activity:alert											
8am (pre)	88	46	60				160	52	Appetite*:				Rxn to palpation**:allow				Activity:alert			167	137	138		465	387	495	
	137	93	110																								
	146	89	109																								
1 hour									0	0	0	0	1	1	0	0	0	0	2								
2 hours									0	0	0	0	1	1	0	0	0	0	2	76	40	103		275	266	265	
4 hours	90	65	70				144	68	0	0	0	0	1	1	0	0	0	0	2	53	101	74		223	397	433	
	114	77	88																								
	126	89	104																								
6 hours									0	0	0	0	0	0	0	0	0	0	0								
8 hours	136	98	111				166	52	0	0	0	0	0	0	0	0	0	0	0	74	64	52		361	502	492	
	149	106	125																								
	109	64	81																								
24 hours	116	77	92				160	56	0	0	0	0	0	0	0	0	0	0	0	399	266	309		315	414	257	
	115	58	96																								
	106	76	87																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepormazine	9.09:10	9.11:30

SURGERY START/END	9.34
ANAESTHESIA OFF TIME	9.13
ANAESTHESIA DURATION	21
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	9.54
STERNAL RECUMBENCY TIME	10.15

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	9.29	94	38	57	90	124	17	1.9/2.1	26	0.5	2	
T1(R skin and tunic)	9.29	90	40	58	98	134	16	2.0/2.1	27	0.5	2	
T2(L Traction and auto)	9.3	88	37	54	96	136	17	2.0/2.1	27	0.5	2	
T3(R skin and tunic)	9.31	89	39	57	96	140	16	2.0/2.1	27	0.5	2	
T4(R traction and autoligation)	9.33	89	37	53	98	140	17	2.0/2.1	29	0.5	2	

Appendix 12:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	10
CASE NO.	61630
CAGE NO.	94
CAT ID	jingga

AGE	7 m.o.
BODY WEIGHT	2.6
BREED	dsh
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30	1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*:good			Rxn to palpation**:allow					Activity:alert										
8am (pre)	90	63	71				160	52	Appetite*:			Rxn to palpation**:allow					Activity:alert			381	546	564		843	502	826	
	137	101	116																								
	141	64	92																								
1 hour									0	0	0	0	0	0	0	0	0	0	0								
2 hours									0	0	0	0	0	0	0	0	0	0	0	322	431	371		674	702	638	
4 hours	177	104	119				128	68	0	0	0	0	0	0	0	0	0	0	0	376	482	522		327	351	369	
	139	99	115																								
	119	82	93																								
6 hours									1	0	0	0	0	0	0	0	0	0	0								
8 hours	119	69	90				180	52	0	0	0	0	0	0	0	0	0	0	0	324	486	357		659	603	387	
	118	51	74																								
	14	54	78																								
24 hours	92	74	84				171	52	0	0	0	0	0	0	0	0	0	0	0	289	364	242		647	640	525	
	115	56	81																								
	144	51	74																								

Induction Agent	Time Given	Time to lateral
Ketamine/acepromazine	9.38:25	9.42:30

SURGERY START/END	10.01/10.04
ANAESTHESIA OFF TIME	10.04
ANAESTHESIA DURATION	19
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.39
STERNAL RECUMBENCY TIME	10.55

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	10.01	77	37	53	86	143	2	2.1/2.1	5	0.5	2	
T1(L skin and tunic)	10.01	79	36	52	88	156	30	2.0/2.1	11	0.5	2	
T2(L Traction and auto)	10.01	85	38	55	98	156	30	2.1/2.1	10	0.5	2	
T3(R skin and tunic)	10.02	85	53	66	102	159	30	2.0/2.0	15	0.5	2	
T4(R traction and autoligation)	10.04	92	46	64	100	162	30	2.0/2.1	13	0.5	2	

Appendix 13:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	11
CASE NO.	:
CAGE NO.	94
CAT ID	put

AGE	8 m.o.
BODY WEIGHT	4.3
BREED	DLH
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables											
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *	Total/30	1st	2nd	3rd	Ave	2 1st	2 2nd	2 3rd	2 Ave
8pm (pre)									Appetite*:good			Rxn to palpation**:allow					Activity:alert										
8am (pre)	90	71	77				240	52	Appetite*:			Rxn to palpation**:allow					Activity:alert			247	319	411		830	739	863	
	109	82	90																								
1 hour									0	0	0	0	1	1	1	0	0	0	3								
2 hours									0	0	0	0	1	1	1	0	0	0	3	255	363	223		329	272	239	
4 hours	101	74	82				212	40	0	0	0	0	1	0	0	0	0	0	1	86	81	117		463	556	549	
	115	68	87																								
	138	65	94																								
6 hours									0	0	0	0	1	0	1	0	0	0	2								
8 hours	128	72	93				212	40	0	0	0	0	0	0	0	0	0	0	0	53	23	19		685	767	690	
	115	68	87																								
	138	65	94																								
24 hours	116	59	83				192	40	0	0	0	0	0	0	0	0	0	0	0	243	295	330		717	827	867	
	119	49	51																								
	93	68	73																								

Induction Agent	Time Given	Time to lateral
ketamine/acepromazine	9.14:05	9.17:30

SURGERY START/END	9.20/9.38
ANAESTHESIA OFF TIME	9.38
ANAESTHESIA DURATION	18
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.14
STERNAL RECUMBENCY TIME	10.35

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	9.35	107	44	64	92	137	15	2.2/2.2	19	0.5	2	
T1(L skin and tunic)	9.35	117	55	79	100	149	13	2.2/2.3	32	0.5	2	
T2(L Traction and auto)	9.35	124	55	78	100	148	14	2.2/2.2	33	0.5	2	
T3(R skin and tunic)	9.37	114	50	72	98	151	24	2.2/2.1	31	0.5	2	
T4(R traction and autoligation)	9.38	119	51	73	102	157	24	2.2/2.1	28	0.5	2	

Appendix 14:

Date of Admission :

Date of Discharge :

Client :

H/P No. :

CAT NO.	12
CASE NO.	:
CAGE NO.	92
CAT ID	hero

AGE	1 y.o
BODY WEIGHT	4.5
BREED	DLH
TEMPERAMENT	good

Time Points (Pre-, Intra-, Post-)	Arterial B.P. ***						Pulse Rate	Resp. Rate	Pain Score											Mechanical Threshold							
	Oscill.			Dopler					Pain Expression				Psychomotor Change				Physio Variables		Total/30	1				2			
									Misc	Wound ** palpation	Abd palpation	Vocal	Posture	Comfort	Activity	Attitude	Arterial B.P.***	Appetite *		1st	2nd	3rd	Ave	1st	2nd	3rd	Ave
8pm (pre)									Appetite*:good				Rxn to palpation**:allow				Activity:alert											
8am (pre)	94	70	78				184	60	Appetite*:				Rxn to palpation**: allow				Activity: alert			368	392	363		907	838	769	
	83	35	74																								
1 hour									0	0	0	0	1	1	0	0	0	0	2								
2 hours									0	0	0	0	1	1	2	0	0	0	4	859	842	842		907	838	795	
4 hours	85	59	68				152	76	0	0	0	0	0	0	0	0	1	0	1	332	408	294		696	592	535	
	94	71	79																								
	122	51	73																								
6 hours									0	0	0	0	0	1	1	0	0	0	2								
8 hours	88	56	64				160	40	0	0	0	0	0	1	1	0	0	0	2	192	156	109		448	432	325	
	113	76	93																								
	100	58	68																								
24 hours	132	75	101				120	72	0	0	0	0	0	0	0	0	0	0	0	214	356	253		620	511	584	
	88	63	71																								
	136	87	106																								

Induction Agent	Time Given	Time to lateral
ketamine/acepromazine	9.42:45	9.45:35

SURGERY START/END	10.00/10.06
ANAESTHESIA OFF TIME	10.06
ANAESTHESIA DURATION	20
QUALITY OF RECOVERY	smooth
START OF RIGHTING TIME	10.56
STERNAL RECUMBENCY TIME	11.19

	Time	Blood Pressure				Pulse Rate	Respiratory Rate	Sevoflurane(Et/Fi)	CO2	Setting		Remark
		Oscillo			Dopler					O2	Sevoflurane	
T0(Baseline)	10	117	47	68	122	184	2	2.1/2.1	1	0.5	2	
T1(l skin and tunic)	10	125	57	82	140	200	2	2.0/2.0	2	0.5	2	
T2(L Traction and auto)	10.01	150	94	117	172	193	1	2.0/2.0	1	0.5	2	
T3(R skin and tunic)	10.05	157	78	110	160	174	15	2.4/2.8	46	0.5	3	
T4(R traction and autoligation)	10.06	118	65	88	140	171	22	2.4/2.5	47	0.5	2	