INFLUENCE OF PREOPERATIVE DEXTROSE INFUSION IN DOGS FOR ELECTIVE SURGERY

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Thesis submitted in partial fulfilment of the
requirement for the degree of

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DECLARATION

I hereby declare that the thesis, entitled **"INFLUENCE OF PREOPERATIVE DEXTROSE INFUSION IN DOGS FOR ELECTIVE SURGERY"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that the thesis, entitled **"INFLUENCE OF PREOPERATIVE DEXTROSE INFUSION IN DOGS FOR ELECTIVE SURGERY"** is a record of research work done independently by Sri. Laiju M. Philip under my guidance and supervision and it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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Laiju M. Philip

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Introduction

1. INTRODUCTION

Elective surgeries in dogs are usually performed in the overnight fasted state so as to reduce the risk of aspiration of gastric contents during the induction of anaesthesia. The routine has been ' *nil per os* ' or NPO meaning that no intake of solids and fluids is allowed from midnight to the day of operation (Agarwal *et al.*, 1989). Even a short period of fasting will change the metabolic state of the patient, as stress of fasting superimposes on stress of anaesthesia and surgery proper. The surgical stress will be exaggerated with preoperative stress and postoperative pain.

Preoperative stress is common in dogs especially separation anxiety and exposure to novel environment (Houpt, 1998). Preoperative anxiety has direct relation with perioperative stress and postoperative pain (Hellyer and Fails, 2002). Surgical trauma along with postoperative catabolism exacerbates pain.

Stress response is the term given to the hormonal and metabolic changes, which follow injury or trauma. The stress response to surgery comprises a number of hormonal changes initiated by neuronal activation of the hypothalamic-pituitary-adrenal axis (Desborough, 2000). This is a part of the systemic reaction to injury, which encompasses a wide range of endocrine, immunologic and haematologic effects. The net effect of the endocrine response to surgery is an increased secretion of catabolic hormones. Surgery causes a hypermetabolic state, which induces enzymatic changes favouring insulin resistance, gluconeogenesis, protein catabolism and muscle wasting. This promotes the provision of food substrates from the catabolism of carbohydrate, fat and protein.

Insulin resistance is a central feature of the metabolic response after elective surgery. Evidence suggests that insulin resistance in surgical stress is not beneficial for favourable clinical outcome. Postoperative insulin resistance has deleterious effect on postoperative recovery and well being of the patients (Nygren *et al.*, 2001).

Nutritional depletion has been demonstrated to be a major determinant of the development of postoperative complications (Ward, 2003). Nutritional status of patients at the time of trauma or surgery influences the biochemical processes necessary for the phases of normal healing to occur. Hence healing in undernourished or malnourished patients is less efficient and they are at greater risk for complications during and after surgery.

Fasting overnight is not an optimal way to prepare patients for elective surgery. The traditional fasting routine was questioned and recent evidence has shown that it is safe to recommend almost all patients about to undergo elective surgery to drink clear fluids up to two to three hours before anaesthesia in human practice. Many anaesthesia societies have changed their recommendations accordingly (Crenshaw and Winslow, 2002). The main advantage is that preoperative carbohydrates have clinical benefits.

Preoperative carbohydrate treatment instead of fasting is a simple way of preparing the patient metabolically for elective surgery. Preoperative parenteral administration of dextrose has reported to be superior to fasted state in reducing the anxiety and consequent endocrine response to surgery in humans. The active preoperative preservation of carbohydrates has metabolic as well as clinical benefits (Ljungqvist *et al.*, 2000). The successful wound healing requires adequate blood and nutrients to be supplied to the site of damage, also the overall health and nutritional status of the patient that influence the outcome of the damaged tissue.

The present study was conducted with the objective to evaluate the effect of preoperative dextrose infusion in alleviating stress, to promote healing and postoperative recovery in dogs for elective surgery.

Review of Literature

2. REVIEW OF LITERATURE

2.1 PREOPERATIVE FASTING

Fasting became popular in human after reporting the link between feeding and aspiration among obstetric patients receiving general anaesthesia (Mendelson, 1946).

Historically, adult patients have fasted 8-12 hr before surgery to reduce the volume of gastric contents and the risk of aspiration pneumonitis. The Latin word *Nulla per os* (NPO) or "nothing by mouth" after midnight was a time-honoured preoperative order and thus became a common medical practice. However, long fasting had detrimental effects like, thirst, hunger, irritability, noncompliance, and resentment in adult patients. It would also produce dehydration, hypovolemia, and hypoglycaemia (Agarwal *et al.*, 1989).

Strunin (1993) stated that fasting before surgery was a well established practice that prevented the aspiration of gastric contents and reduced the risk of regurgitation and vomiting in human patients.

The physiological and hormonal adaptations to starvation in healthy dogs are similar to those in human beings. Energy that could be used by the body during complete food deprivation is stored in three forms: hepatic glycogen, triglycerides within the adipocytes and amino acids. The quality of glycogen stored in the liver is capable of supporting normoglycaemia for only 8 to 12 hours. (Mauldin and Davidson, 2002).

Watson and Rinomhota (2002) reported that human patients who endure excessive periods of fasting were unable to resume their normal eating habits following surgery due to postoperative nausea/vomiting and became malnourished and dehydrated contributing to postanaesthetic mortality and morbidity.

Ward (2003) stated that nutritional depletion had been demonstrated to be a major determinant of the development of post-operative complications in human beings. Nutritional depletion was associated with changes in body composition, tissue wasting and impaired organ function, leading to impaired immune and muscle function.

2.2 STRESS

2.2.1 Preoperative Stress

Hennessy *et al.* (1997) reported that psychological stressors in a dog confined in public animal shelter included social separation and exposure to novel surrounding, noise, restraint, disruption of familiar habits.

Houpt (1998) stated that separation anxiety in dogs would be manifested in many different ways. Some dogs might be destructive, other dogs would bark all day or urinate and defaecate in the house.

Hellyer and Fails (2002) reported that anxiety played a significant role in exacerbating pain, distress and in behavioural signs that ultimately shown in the perioperative period.

Anxiety would initiate catecholamine release harming the cardio-respiratory impulses due the exaggeration of the oxygen consumption and haemodynamic responses. (Singh, 2003).

Väisänen *et al.* (2005) studied behavioural characteristics of preoperative stress in healthy dogs hospitalised for elective surgery. Animals were highly active, and seen to bark or howl, or attempt to flee vigorously. Panting and displacement behaviour such as snout licking were also observed before elective surgery.

2.2.2 Anaesthesia and Surgery

Moon (1997) reported that anaesthesia and surgery even for elective procedures are stressful events.

The stress response to surgery comprised of number of hormonal changes initiated by neuronal activation of hypothalamo-pitutary adrenal axis (Desborough, 2000).

Benson *et al.* (2000) stated that stress in perioperative period could be variable due to stressors that included anxiety and apprehension caused by a stress environment, pre-existing pathology, surgery, trauma and pain. Anaesthetic induction was also associated with stress response in dogs.

The stress response to surgery would depend on the extent of injury and duration. General anaesthesia would not abolish the response completely as hypothalamus remains reactive to the noxious stimuli even in the deeper planes of anaesthesia. (Singh, 2003).

Ward (2003) stated that the physiological stress of surgical trauma in human beings caused a surge of sympathetic activity and rise in catecholamine secretion and increased energy expenditure associated with a range of hormonal responses that occurred as a result of surgical trauma.

2.2.3 Postoperative Pain

Hilgard *et al.* (1975) stated that the need to avoid tissue damage is essential to the survival of any organism. Even a weak pain stimulus would dominate other stimuli in controlling the direction of behaviour. Pain leads to any behaviour that would reduce the discomfort.

According to Schricker (2001) pain is regarded as a potent trigger for the catabolic response to surgery.

Fear, anxiety, emotions and tension significantly reduce pain tolerance. The exaggerated pain sensation affect neuroendocrine response by stimulating the hypothalamic-pituitary-adrenal–sympathetic axis resulting in release of all catabolic

and anabolic hormones. The pain sensation cause sympathetic stimulation even in deeper planes of anaesthesia during skin incision (Singh, 2003).

2.2.4 Endocrine Response to Stress

Armario *et al.* (1996) reported that the circulating catecholamines, the pituitary-adrenal axis and prolactin were directly related to the intensity of the stressful situation and anxiety-provoking situations increased plasma cortisol, prolactin and glucose levels.

According to Möstl and Palme (2002) the adrenal glands have a key-role in hormonal reactions to stress, as they are involved both in the hypothalamic–pituitary–adrenocortical axis and the symphatho-adrenomedullary system. They reported the use of cortisol concentration in blood as an indicator of stress in human beings.

2.2.5 Postoperative Insulin Resistance

Soop *et al.* (2001) reported that insulin sensitivity would decrease in the immediate postoperative period because of the possible appearance of stress endocrine and paracrine mediators. The day of surgery was associated with a preoperative and perioperative period of fasting and immobilization that would contribute to postoperative insulin resistance. Surgery caused a state not unlike non-insulin-dependent diabetes mellitus.

Surgical trauma had marked effect on insulin stimulated glucose transport and would cause insulin insensitivity in rats. (Stro¨mmer *et al.*, 2001).

2.2.6 Metabolic Responses to Stress

Desborough (2000) stated that the net effect of endocrine response to surgery was an increased secretion of stress hormones to promote the provision of food substrates from the catabolism of carbohydrates, fat and protein through hepatic

glycogenolysis and gluconeogenesis, protein catabolism and lipolysis in a study on human patients.

Restriction in the carbohydrate intake during fasting and subsequent alteration in the glucose metabolism would be an important signal for triggering the initial metabolic response in humans (Horowitz *et al.*, 2001).

Gluconeogenesis contributed more than 90 per cent to total glucose production under perioperative condition, a consequence of the fasting induced depletion of glycogen stores and the stimulatory effect of counter regulatory hormones in a study on human (Lattermann *et al.*, 2003).

Singh (2003) stated that the cortisol and other glucocorticoids have the ability to stimulate gluconeogenesis by liver as much as 6 to 10 folds during stress. Cortisol mobilizes amino acids from the extra hepatic cells converting it into glucose. It would also decrease and delay the rate of glucose utilization in spite of increased insulin secretion, blood glucose concentration increases up to 50% of the normal. Cortisol would help in mobilization of fatty acids from the adipose tissues and also increases oxidation of fatty acids in the cells, changing the metabolic system of the cells in times of starvation or stress from utilization of glucose for energy.

2.2.7 Effect of Stress on Wound Healing

Dahanukar *et al.* (1996) reported that a significant post-operative depression in polymorphonuclear and monocyte functions associated with a rise in serum cortisol level in human patients. Both phagocytic and bactericidal functions of these cell types were depressed. Surgery depressed immune functions and caused rise in serum cortisol.

Hensler *et al.* (1997) reported that altered host defense mechanism after major surgery or trauma considered important for development of infectious complications and sepsis in humans. Suppression of T-cell function rather than

monocyte function was a critical mechanism of immunosuppression following major surgery.

According to Hobel and Culhane (2003) moderate-to-high levels of glucocorticoids could exert several direct effects on the immune system in humans. Cortisol would indirectly affect the immune system by modulating the expression of the parasympathetic and sympathetic components of the nervous system on thymocytes, monocytes and macrophages.

Acute response to surgery consist of an intricate interplay between the neuroendocrine and immune systems, which eventually lead to immunosuppression, by an interaction among various aspects of surgery like tissue damage, blood loss, hypothermia, pain and preoperative anxiety (Shakhar and Ben-Eliyahu, 2003).

The successive phases of wound healing depend on the respective preceding phase. Slowing of the initial inflammatory phase would delay onset of following phases thus slowing the overall healing process. Stress-induced elevations of glucocorticoid levels were responsible for the slowing of the cutaneous healing process (Ebrecht *et al.*, 2004).

2.2.8 Postoperative Recovery

High preoperative fear or stress in human patients is predictive of a variety of poorer outcomes, including greater pain, longer hospital stays, more postoperative complications, and poorer treatment compliance (Kiecolt-Glaser *et al.*, 1998).

Soop *et al.* (2001) stated that the degree of postoperative insulin resistance was found to be an independent factor determining the variation in the length of postoperative hospital stay (LOS) in haman patients. LOS was considered a measure of speed of postoperative recovery of functions of daily living

Protein energy malnutrition is potentially associated with higher complication rates, prolonged hospital stays, and sub optimal responses to primary therapy in humans (Mauldin and Davidson, 2002).

Pandey and Singh (2003) opined that preoperative dehydration due to prolonged fasting period would contribute to prolonged hospital stay. Postoperative dizziness and drowsiness are independent predictors of prolonged hospital stay, after ambulatory surgery in humans.

2.3 PREOPERATIVE NUTRITION

Wolfe (1993) reported that glucose exerts its anticatabolic action through the suppression of gluconeogenesis and a reduced need for gluconeogenic amino acids released from the muscle.

Nygren *et al.* (1998) investigated the effects of insulin and glucose infusion in human patients before and after surgery on postoperative substrate utilization and insulin sensitivity and found that it minimized the endocrine stress response and normalized postoperative insulin sensitivity and substrate utilization.

In 1999 the American Society of Anesthesiology (ASA) revised its practice guidelines for preoperative fasting in healthy patients undergoing elective procedures. These guidelines allowed the consumption of clear liquids up to two hours before elective surgery, a light breakfast (tea and toast) six hours before the procedure, and a heavier meal eight hours beforehand (Crenshaw and Winslow, 2002).

Soop *et al.* (2001) studied the effect of 12.5 per cent carbohydrate rich beverage 2.5 hours before the estimated time of surgery in humans and found that oral carbohydrate treatment shortly before surgery attenuated the decrease in whole body insulin sensitivity immediately after surgery.

Stro¨mmer *et al.* (2001) studied the effect of carbohydrate feeding on insulin action in rat and found that preoperative glucose supplementation would not ameliorate the development of postoperative insulin resistance. But the fed animals exhibited physiologic hyperinsulinaemia at the time of surgery.

Lattermann *et al.* (2002) stated that the preservation of glucose homeostasis in surgical patients was found to be important because acute hyperglycemia, a typical feature of the metabolic response to surgery, would significantly compromise immune function.

Naguib *et al.* (2002) reported that administration of 60 ml of honey, glucose-fructose-sucrose-maltose, apple juice or water to elective surgical patients two hours before surgery resulted in small volume of fluid increase in residual gastric volume without changes in the gastric pH in a study on human patients.

General and regional anaesthetics would cause reduction in cardiac output. Infusing fluids to increase the preload would return the stroke volume to an acceptable range. Compensatory intravascular volume expansion required five to seven ml per kg of balanced salt solution just before or during induction of anaesthesia. Preoperative administration of glucose-containing fluid has been found to reduce postoperative insulin resistance. Administration of 1200 ml 12.5% glucose solution preoperatively led to improvements in preoperative hunger, thirst and anxiety (Pandey and Singh, 2003).

Singh (2003) opined that the appropriate pre-operative fluid therapy with sufficient amount of glucose was essential to maintain fluid balance and calorie requirement to avoid undue catabolism in human patients.

Maltby *et al.* (2004) studied obese patients who drank 300ml of clear liquid two hours before their scheduled time of surgery had a similar range of residual gastric fluid volume and pH as that of patients who were fasted for more than 12 hours. Obese patients without co- morbid conditions should follow the same fasting

Gaynor *et al.* (1996) reported that administration of polyionic crystalloids solution or dextrose-containing solution at rates up to 15 ml/kg/hr for 1.5 hours did not have significant effect on packed cell volume in healthy anaesthetized dogs subjected to elective surgical procedures.

Lemke *et al.* (2002a) detected generalised leucopenia immediately after surgery and mild leucocytosis with concurrent neutrophilia and lymphopenia 12 hours after ovariohysterectomy in dogs. He also observed decreased haemoglobin concentration and haematocrit value immediately after surgery.

Mauldin and Davidson (2002) stated that decreased total lymphocyte count was typical with protein energy malnutrition in humans.

2.4.3 Biochemical Parameters

2.4.3.1. Cortisol

Schmidt and Booker (1982) reported significant increase in serum cortisol concentration postoperatively and reached normal by 72 hours in dogs after ovariohysterectomy.

Frank *et al.* (1992) compared serum cortisol concentration before and after intradermal testing in sedated and non sedated dogs and found that sedation with xylazine decreased endogenous cortisol concentration after intradermal testing.

Church *et. al.* (1994) measured plasma cortisol concentration in dogs subjected to major abdominal, thoracic or orthopaedic surgeries and compared to a group of anaesthetized dogs. Anaesthesia alone failed to significantly alter plasma cortisol level and all forms of surgery produced a significant increase in plasma cortisol, which returned to normal by 24 hours after completion of surgery.

Fox *et al.* (1994) measured total plasma cortisol concentration using radio immunoassay in bitches subjected to surgery and found that a marked increase in the

plasma concentration were maintained for nearly two hours after extubation and returned to normal by 24 hours after surgery.

Beerda *et al.* (1996) studied stress induced response in saliva cortisol, urinary cortisol and urinary catecholamine relative to plasma cortisol and found that insulin-induced hypoglycemia would cause significant increase in plasma cortisol concentration in dogs. He observed plasma cortisol concentration in dogs as 58 nmols/l.

Hansen *et al.* (1997) measured plasma cortisol concentrations preoperatively, at extubation, one, three, six and 12 hours after ovariohysterectomy in bitches and found elevation of plasma cortisol concentration at three and six hours after extubation. He observed that dogs underwent ovariohysterectomy developed higher plasma cortisol up to 12.15 µg/dl during 3 to 6 hours.

Hennessy *et al.* (1997) assessed physical stressors in dogs confined to country animal shelters and suggested that plasma cortisol concentration could provide useful measure of the responsiveness of dogs to stressful situations.

Fox *et al.* (1998) studied plasma cortisol concentration in bitches in response to different combinations of halothane and butorphanol subjected to ovariohysterectomy and suggested that a significant distress was present for a duration of more than five hours after surgery in the absence of effective analgesia. Elevation in the plasma cortisol concentration persisted beyond five hours but it had apparently resolved by 24 hours.

Kyles *et al.* (1998) reported that mean plasma cortisol concentration increased to 10 to 15 µg/dl immediately after surgery in dogs underwent ovariohysterectomy.

Nygren *et al.* (1998) reported that serum cortisol level did not differ significantly between human patients received perioperative insulin and glucose infusion before and after surgery and control group, but during postoperative period cortisol level decreased by 65 per cent in the insulin group.

Smith *et al.* (1999) stated that cortisol concentration could be affected by many physiological and psychological factors and increased with duration of surgery. The concentration of cortisol that was part of the neuroendocrine response to surgical stress could be used as good indicator of postoperative pain.

Benson *et al.* (2000) measured perioperative stress response in dogs subjected to ovariohysterectomy and found that cortisol increased significantly in response to surgical manipulation increasing during the surgical period and peaking near the end of manipulation or shortly after recovery from anaesthesia. The stress response to ovariohysterectomy was short lived and had returned to preoperative value by five hours after completion of surgery and baseline value by 24 hour post surgery.

2.4.3.2 Glucose

Armario *et al.* (1996) stated that plasma glucose was a better marker of anxiety than cortisol. Mean values would be able to discriminate between situations provoking substantially different levels of anxiety in human patients.

Gaynor *et al.* (1996) studied the effect of intravenous administration of fluids in healthy halothane anaesthetized dogs underwent elective surgical procedures. Hyperglycaemia developed in dogs administered with five per cent dextrose in water but resolved two hours after discontinuing administration of fluids. When blood glucose concentration exceeded 300 mg/dl, several complications developed.

Somboonviboon and Kijmahatrakul (1996) measured blood glucose concentration in 84 paediatric patients of different age groups who were scheduled for surgery and found that preoperative fasting for eight to 12 hours did not cause

hypoglycemia, but increased postoperative glucose values due to stress response from surgery and anesthesia.

Chambrier *et al.* (1999) compared the effect of intraoperative administration of 2.5 per cent glucose or ringers solution on the metabolism during prolonged surgery. There was a significant increase in the blood glucose level at the end of surgery and two hours thereafter.

Glucose concentration could be used as an indicator of increased surgical stress because blood glucose concentrations were significantly increased at the time of extubation in cats but it could not be used as a useful indicator for pain. (Smith *et al.*, 1999).

Soop *et al.* (2001) observed glucose concentration increased from control basal concentration in placebo group and not in the carbohydrate group who received 400 ml of carbohydrate beverage within 10 minutes on the morning of the day of operation 2.5 hours before estimated time of surgery in humans.

Ali and Al-Qarawi (2002) opined that the hyperglycemic effect of xylazine would be due to synergistic action of cortisol, catecholamine and glucagon released in stressful condition. Xylazine induced hyperglycaemia might be due to α2 mediated inhibition of insulin release and increased hepatic mobilization of glucose.

Lemke *et al.* (2002b) reported that mean glucose concentration was significantly decreased 8 hours after surgery compared with day before surgery in dogs underwent ovariohysterectomy.

2.4.3.3 Total Protein and Albumin

Gaynor *et al.* (1996) reported that administration of polyionic crystalloids solution or dextrose-containing solution at rates up to 15 ml/kg/hr for 1.5 hours did not have significant effect on total protein in healthy anaesthetized dogs subjected to elective surgical procedures.

Lemke *et al.* (2002a) observed plasma protein concentration decreased significantly immediately after surgery and increased significantly by 24th hour after ovariohysterectomy in dogs.

Mauldin and Davidson (2002) stated that hypoproteinaemia was found to be a reliable indicator of protein deficiency and serum albumin concentration was the single most reliable nutritional marker for predicting complications and poor clinical outcome.

2.4.3.4 Blood Urea Nitrogen

Schmidt and Booker (1982) reported that blood urea nitrogen significantly increased up to two weeks after ovariohysterectomy in dogs.

Crowe *et al.* (1984) studied the effect of preoperative glucose loading on postoperative nitrogen balance. High dose glucose infusion markedly reduced overall urea and 3-methyl hystidine excretion indicated a reduction in protein break down.

Chambrier *et al.* (1999) reported that nitrogen balance was found to be general marker for protein catabolism.

Chandler *et al.* (2000) reported that administration of five per cent glucose solution caused a small degree of improvement in nitrogen balance in fasted dog due to protein sparing effect. Blood urea nitrogen was consistent with the break down and deamination of the amino acids by the liver for gluconeogenesis.

2.4.3.5 Sodium and Potassium

Gaynor *et al.* (1996) reported that rapid administration of glucose would result in hypokalemia as protein moved intracellularly. Excessive administration of dextrose five per cent resulted in increased blood volume that lead to increased renal excretion of sodium and water.

Pettifer (2002) stated that antidiuretic hormone release secondary to pain, injury, anaesthesia, haemorrhage, shock and sepsis would cause hyponatremia.

Metabolic acidosis, marked tissue necrosis and insulin deficiency would cause hyperkalemia.

2.5 WOUND HEALING

Varma *et al.* (1981) evaluated tissue reaction to suture material in infected surgical wound using haematoxylin and eosin staining. Evaluating the width of reaction zone and cell types. They assessed the tissue responses on sixth, 10^{th} ,20^{th} and 40^{th} days. Cellular reaction varied with different suture materials. Neutrophils were the predominant cells in acute infection, later macrophages and fibroblast predominated.

Ultrasound represented the only method for measuring skin thickness that was noninvasive, harmless, reproducible, and usable at each anatomic location and it has been successfully employed in assessing normal skin and also for studying a variety of conditions and wound healing (Seidenari, 1995).

Ultrasound scanning was a rapid and precise method of determining skin thickness and the accuracy of the method was good compared to the histometric or radiological determination of skin thickness Ultrasound afforded the possibility of noninvasive assessment of multiple skin areas (Varila *et al.*, 1995).

Swaim *et al.* (1996) studied the effect of locally injected medication on healing pad wounds in dogs. Wound biopsy specimen taken on third, sixth and 14^{th} days stained with H& E, toluidine blue, and Masons trichrome for routine histological evaluation and collagen type quantification to evaluate the healing rate. The general healing pattern for all the wounds were similar with regard to cellular and fibrous components. Neutrophil remained as the predominant inflammatory cell during day three through 14 with some macrophages. Increasing collagen amounts paralleled fibroblast number, progressively increased from day three through 14.

Wound healing rate, wound healing time and histopathology analysis were direct and efficient criteria of wound healing (Huang and Chen, 2001).

Sylvestre *et al.* (2002) compared postoperative wound healing after canine ovariohysterectomy following the use of an absorbable monofilament polyglecaprone 25 and non-absorbable monofilament polypropylene. Wounds were assessed using a semi quantitative scoring system at 18 to 24 hours and 10 to 14 days, postoperatively based on swelling, erythema, dehiscence, and discharge.

Diana *et al.* (2004) assessed the applicability of high frequency diagnostic ultrasonography for evaluation and accurate measurement of the skin thickness of clinically normal dogs. Comparison between ultrasonographic and histologic appearance of the skin revealed that layering of canine skin and subcutaneous tissue could be recognized and measured by the use of high frequency ultrasonography. She reported that in ultrasonographic pattern of canine skin the distance between the first hyperechoic line (epidermis) and the acoustic interface between dermis and sub cutis was 5 mm. Diagnostic ultrasonography might be a useful tool for the non-invasive evaluation of cutaneous disorders in dogs.

2.6 POSTOPERATIVE RECOVERY AND PAIN

Animals are incapable of describing pain and the changes in the physiological parameters and behaviour are helpful in determining the presence of pain. The most recognized behavioural manifestation of pain is vocalizing. Other behavioural and clinical indications of pain included changes in posture or facial expressions, guarding or protecting, self mutilation, dilated pupils, salivation, muscle rigidity or weakness, changes in sleeping, eating and elimination patterns (Carroll, 1996).

Hardie *et al.* (1997) studied the postoperative behaviour of caged dogs after ovariohysterectomy. Surgery resulted in an increase in pain score, sedation score and time spent sleeping. The behavioural indices of post surgical distress apparently persist until at least 24 hour. Surgery caused the dogs to spend more time sleeping in lateral recumbency during 12 hours after surgery and to spend more time sleeping in sternal recumbency between 12 and 24 hours after surgery. Surgery resulted in less

time spent standing during zero to six hours after surgery. Surgery reduced grooming and increased licking of abdominal midline. Surgery caused dog to exhibit less normal tail wagging, orienting, lip licking and vocalisation during interaction with handler. He assessed sedation scores in dogs after ovariohysterectomy and found that during 18 to 24 hours animals were slightly to faintly sedated state in which they were capable of standing and walking with slightly ataxic or disoriented.

Lascelles *et al.* (1997) observed dogs underwent ovariohysterectomy showed a greater level of sedation immediate postoperatively and gradually declining to zero at 20 hour post extubation.

Fox *et al.* (1998) reported that ovariohysterectomy caused significant distress in dogs for duration of more than 5 hours after surgery in the absence of effective analgesia.

Kyles *et al.* (1998) reported that mean numerical sedation score increased during zero to six hours in dogs underwent ovariohysterectomy and reduced during 18 to 24 hours and VAS pain scores increased during zero to six hours and reduced by 12 to 18 hours. Quantitative behavioural analysis was more objective and reproducible method of assessing pain in animals.

Lascelles *et al.* (1998) used the dynamic and interactive visual analogue scale (DIVAS) scoring system to assess postoperative pain in dogs underwent ovariohysterectomy. Sedation was assessed by observation of dog's posture, its degree of mental alertness and its ability to stand and walk. The degree of pain present was assessed by observation of the patient for signs of crying, whimpering, restlessness, discomfort and by the response to few pressure applied to the surgical wound.

Nygren *et al.* (1998) suggested that performing surgeries with the patient in fed state instead of traditional fasted state made possible a completely different starting point for postoperative nutrition and recovery in humans.

Firth and Haldane (1999) designed and evaluated a scale for measurement of postoperative pain in dogs. The pain scale incorporated physiologic data like heart rate and respiratory rates and behavioural responses like activity, mental status, posture, vocalization and response to palpation. Behavioural and physiological measurements can be used reliably to evaluate degree of pain in dogs during the postoperative period and their response to analgesics.

Slingsby and Waterman-Pearson (2000) used mechanical nociceptive threshold and visual analogue scale (VAS) before premedication and at 20 minutes, one, two, four, eight and 18 hours after exubation to compare pre and postoperative administration of the ketamine on postoperative analgesic effect after canine ovariohysterectomy. VAS sedation scores were reached a maximum 20 minutes after extubation and fell thereafter to zero by 18 hours after surgery. The VAS pain scores increased significantly from two to 18 hours after surgery from presurgery value of zero.

Soop *et al.* (2001) reported preoperative carbohydrate treatment largely attenuated postoperative diabetic state, so postoperative nutrition might be better utilized, contributing faster recovery and less discomfort after elective surgery in human beings.

Lemke *et al.* (2002b) studied the effect of preoperative administration of ketoprofen on anaesthetic requirement and signs of postoperative pain in dogs underwent elective ovariohysterectomy. They used numerical pain score and objective behavioural score based on posture, mentation, vocalization and movement and suggested that the objective behavioral score might be a more sensitive measure of acute postoperative pain than traditional numerical pain score.

Väisänen *et al.* (2004) studied postoperative signs in dogs underwent soft tissue surgery. On the day of operation there were behavioral changes in all the animals, but by two days after operation changes in behaviour were detected in 85

percent of them. Vocalization was the behaviour most commonly observed by the owners as an indicator of pain. The most common changes were in the dog's demeanour and their way of moving; there were decreased overall activity and playfulness, and increased contact seeking. He also observed appetite clearly decreased on the day of operation and decreased to some extent on 2^{nd} and 3^{rd} day postoperatively.

Materials and Methods

3. MATERIALS AND METHODS

The study was carried out in twelve clinically healthy nondescript bitches with age ranging from 8 months to 2.5 years presented to the clinics of College of Veterinary and Animal Sciences, Mannuthy for panhysterectomy. The animals were divided into two groups (I and II) and the animals in each group were serially numbered from 1 to 6.

In Group I – Panhysterectomy was done under general anaesthesia after overnight fasting and Group II - Panhysterectomy was done under general anaesthesia after overnight fasting and administration of 12.5 per cent dextrose at the rate of 5 ml per kg body weight intravenously two hours prior to induction of anaesthesia.

3.1 PREOPERATIVE CONSIDERATION

The animals were admitted in kennels at the inpatient ward of the clinics one week before the date of surgery. They were dewormed, fed once a day and water provided *ad libitum*. The anamnesis of the animals concerning their reproductive state prior to their admittance into the ward was unknown and hence ultrasound scanning of abdomen was performed to determine the status of uterus to rule out pregnancy. Following general check up, the animals were fasted overnight, and were subjected for the study. Prior to premedication, animals were observed for the behavioural and physiological responses to preoperative stress and were recorded. The ventral abdomen from the xyphoid to pubis was clipped, shaved and prepared aseptically.

3.2 ANAESTHESIA

3.2.1 Preanaesthetic medication

All the animals were premedicated with atropine sulphate[1] intramuscularly at the rate of 0.045 mg/ kg body weight. After 10 minutes xylazine[2] at the rate of 1.5 mg/ kg body weight was administered intramuscularly.

3.2.2 General anaesthesia

Ten minutes after administration of the preanaesthetic medications, general anaesthesia was induced by intravenous administration of xylazine- ketamine[3] combination (xylazine 20 mg/ml and ketamine 50 mg/ml) to effect and maintained on surgical plane of anaesthesia.

Time for induction of anaesthesia, duration of anaesthesia, recovery from anaesthesia and complication, if any were recorded in all the animals. Time for induction of anaesthesia was assessed by noting the time from injection of xylazine - ketamine combination until the disappearance of palpebral reflex. Duration of anaesthesia was calculated as the time from induction and regaining of pedal and palpebral reflex. Recovery from anaesthesia was calculated as the time from induction to rising of head voluntarily.

3.3 SURGERY

3.3.1 Procedure

Animal was controlled on dorsal recumbency and midline incision of about seven centimeter was made beginning from umbilicus and extended caudally through skin and subcutaneous tissues to expose the *linea alba*. Grasped the *linea alba,* tent it

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[1] ATROPINE SULPHATE (0.6 mg/ml) injection: Hindustan Pharmaceuticals,Barauni.
[2] XYLAXIN: Xylazine hydrochloride injection (20 mg/ml), Indian Immunologicals Ltd., A. P.
[3] KETMIN 50: Ketamine hydrochoride injection (50 mg/ml), Themis MedicareLtd,Mumbai.

outward and made a nick incision into the abdominal cavity (Fig.1). Extended the incision on *linea alba,* cranial and caudal to the nick incision with scissors. The right uterine horn was located by means of the index finger. A clamp was applied over the proper ligament of the ovary through a window made on the mesovarium caudal to the ovarian vessels. Placed circumferential ligature around the ovarian pedicle using chromic catgut (1-0) and transfixed the ligature (Fig.2). A ligature was applied caudal to the ovary, then opened the ovarian bursa and dissected out the ovary (Fig.3). This procedure was repeated on the opposite ovarian pedicle and the broad ligament of uterus on either side was torn caudally. A clamp was placed on the body of the uterus just cranial to the cervix (Fig.4). The uterine arteries and the uterine body were individually ligated caudal to the distal clamp and severed between the proximal and middle clamp (Fig.5). The ovarian pedicles and uterine stump were inspected for bleeding after releasing the clamps and gently replaced into the abdomen ensuring complete haemostasis. Closed the abdominal wall in three layers, the *linea alba* was sutured in simple continuous pattern using braided silk (1-0), subcutaneous suture was applied using braided silk (1-0) and apposed the skin incision using monofilament nylon in simple interrupted pattern (Fig.6). The sutured wound was sealed with Povidone iodine- Metranidazole™[1] spray.

3.3.2 Postoperative Care

Postoperatively, injection of Amoxycillin Cloxacillin[2] at the dose rate of 10 mg/kg was administered twice daily intramuscularly for 3 days. Self mutilation of surgical wound was prevented by applying multitailed abdominal bandage. All the animals were maintained on identical condition of feeding and management, and were observed for a period of 8 days. The skin sutures were removed on 8th day postoperatively.

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[1] Healz™ spray – Povidone iodine and metranidazole spray (40g), Orange health care Pvt. Ltd., Chennai.

[2] INTAMOX 0.5 g – Amoxycillin sodium IP 250mg and Cloxacillin sodium IP 250mg / ml , Intas Pharmaceuticals Ltd., Vadodara.

3.4 MAIN ITEMS OF OBSERVATION

During the period of study, the following observations were made.

3.4.1 Physiological Parameters

Rectal temperature (°C), Pulse rate (per min), Respiration rate (per min), Colour of mucous membrane and Capillary refill time (sec) were recorded before surgery, immediately after surgery, at 24th hr, on 4th day and 8th day.

Collection of blood samples

The blood samples for haematological and biochemical parameters were collected from cephalic vein in heparinised syringes. Plasma for the estimation biochemical parameters, was separated by centrifuging at 5000 rpm for 10 minutes. Plasma for estimation of cortisol was stored at – 20 °C until assayed.

3.4.2 Haematological Parameters

Differential leucocyte count (DLC) (per cent), volume of packed red cells (VPRC) (per cent), white blood cell count (WBC) (10^3/Cu.mm), and haemoglobin (Hb)(g/dl) concentration[1] (Benjamin, 1985) were estimated before surgery, immediately after surgery, at 24th hr, on 4th day and 8th day.

3.4.3 Biochemical Parameters

Cortisol concentration (µg/ml) was estimated before surgery, immediately after surgery and at 24th hour postoperatively in Group I, and before dextrose infusion, before surgery, immediately after surgery and 24th hour postoperatively in Group II using Clinical Assays™ GammaCoat™ Cortisol ^{125}I RIA Kit[2] by radioimmuno assay.

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[1] HAEMOCHEK – Agappe Diagnostics, Thane, Maharashtra.
[2] Clinical Assays™ GammaCoat™ Cortisol ^{125}I RIA Kit - DiaSorin, Minnesota, U. S. A.

Glucose concentration (mg/dl) was estimated using Glucose kit[1] before surgery,immediately after surgery, at 24th hour, on 4th day and 8th day post operatively by GOD-PAP method.

Total protein (g/dl) and albumin (g/dl) were estimated using total protein[2] and albumin[3] kit before surgery, immediately after surgery, at 24th hour, on 4th day and 8th day post operatively by direct Biuret method and Bromocresol green method respectively. The globulin content (g/dl) was determined by finding the difference between total protein and albumin.

Blood urea nitrogen concentration (mg/dl) was estimated using urea kit[4] before surgery, immediately after surgery, at 24th hour, on 4th day and 8th day post operatively by modified Berthelot method.

Sodium and potassium concentrations (mEq/l) were estimated before surgery, immediately after surgery, at 24th hour, on 4th day and 8th day post operatively by flame photometric method.

3.5 EVALUATION OF WOUND HEALING

3.5.1 The Clinical Appearance of the Surgical Wound was scored at 3 time points: at 24th hr, on 4th day and 8th day post operatively based on swelling, erythema, dehiscence, and discharge (Sylvestre *et al,* 2002). Criteria used to score appearance of wounds are given in Table 1.

3.5.2. Histopathology

Biopsy of the surgical wound was performed on 4th day and 8th day from two dogs of each group. The samples were fixed in 10 per cent buffered formalin. The

[1] LYPHOCHEK – Agappe Diagnostics, Thane, Maharashtra.
[2] CHEMCHEK – Total protein colorimetric test, Agappe Diagnostics, Thane, Maharashtra
[3] CHEMCHEK –Albumin colorimetric test, Agappe Diagnostics, Thane, Maharashtra
[4] LYPHOCHEK – Urea enzy-colorimetric test, Agappe Diagnostics, Thane, Maharashtra

specimen were paraffin embedded, sectioned at 3 to 4 micrometer and stained with haematoxylin and eosin for histological evaluation (Bancroft and Cook, 1984)

3.5.3 Ultrasound Scanning of the Wound Site was performed on 4th and 8th postoperative day using ultrasound scanner (L & T Medical, Symphony, Mumbai.), at a frequency of 7.5 MHz.

3.6 ASSESSMENT OF PATIENT DURING POSTOPERATIVE RECOVERY PERIOD

3.6.1 Activity and Alertness were recorded using sedation scale and pain scale based on the postoperative behaviour immediately after surgery at 0th hour, 1st hour, 3rd hour, 6th hour, 12th hour, 24th hour, on 2nd day and up to 8th postoperative day

3.6.2 Feeding Habits were assessed daily up to 8th postoperative day.

3.6.3 Behavioral Changes and Deviation from Normal Behavior were recorded from immediately after surgery at 0th hour, 1st hour, 3rd hour, 6th hour, 12th hour, 24th hour, on 2nd day and up to 8th postoperative day. Postoperative behaviors like lateral recumbency, sternal recumbency, positional changes, standing, walking, tail wagging, licking of wound site and self grooming were assessed. Extend of behavioural changes were recorded as +2 for clearly increased, +1 for increased to some extent, 0 for no chage in behaviour, -1 for decreased to some extend and –2 for clearly decreased. (Väisänen *et al.* 2004)

3.6.4 Clinical well being was assessed based on the postoperative behaviours from day 1 to day 8.

3.6.5 Sedation Score (Hardie *et al.,* 1997) was recorded immediately after surgery at 0th hour, 1st hour, 3rd hour, 6th hour, 12th hour, 24th hour, on 2nd day and up to 3rd postoperative day. Sedation was assessed by observation of dog's posture, it's degree of mental alertness and its ability to stand and walk. (Table 2.)

3.6.6 Pain Score was recorded from immediately after surgery at 0^{th} hour, 1^{st} hour, 3rd hour, 6th hour, 12th hour, 24^{th} hour, on 2^{nd} day and up to 3^{rd} postoperative day based on the postoperative behaviour. (Hardie *et al.*, 1997; Kyles *et al.*, 1998; Lascelles *et al.* 1998; Firth and Haldane, 1999; Lemke *et al.*, 2002b; Väisänen *et al.* 2004). For assessment of postoperative pain, animals were observed initially while they were undisturbed, then they were approached, gently handled and encouraged to walk. Pain scores were recorded based on pain behaviors during the observation and interaction with the animal (Table 3).

Statistical analysis

The physiological, haematological and biochemical parameters recorded were statistically analysed. Within group comparison of data using Paired t-Test and between group comparison using Students t-Test were performed (Snedecor and Cochran, 1989).

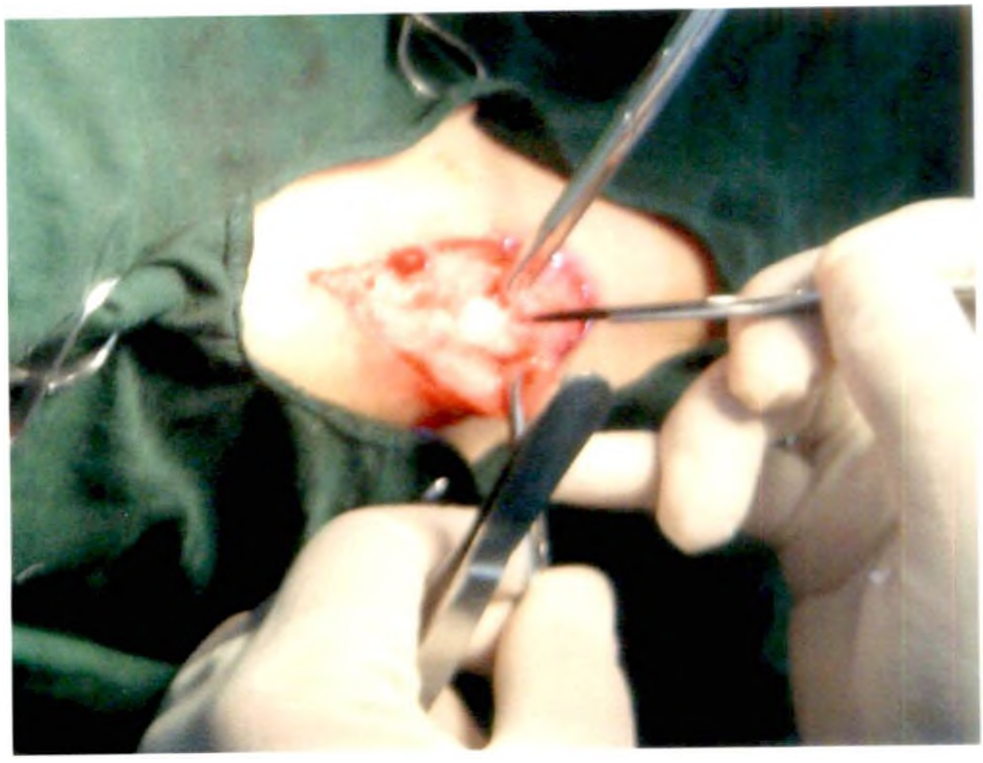

Fig. 1. Incising the linea alba to expose the abdominal cavity

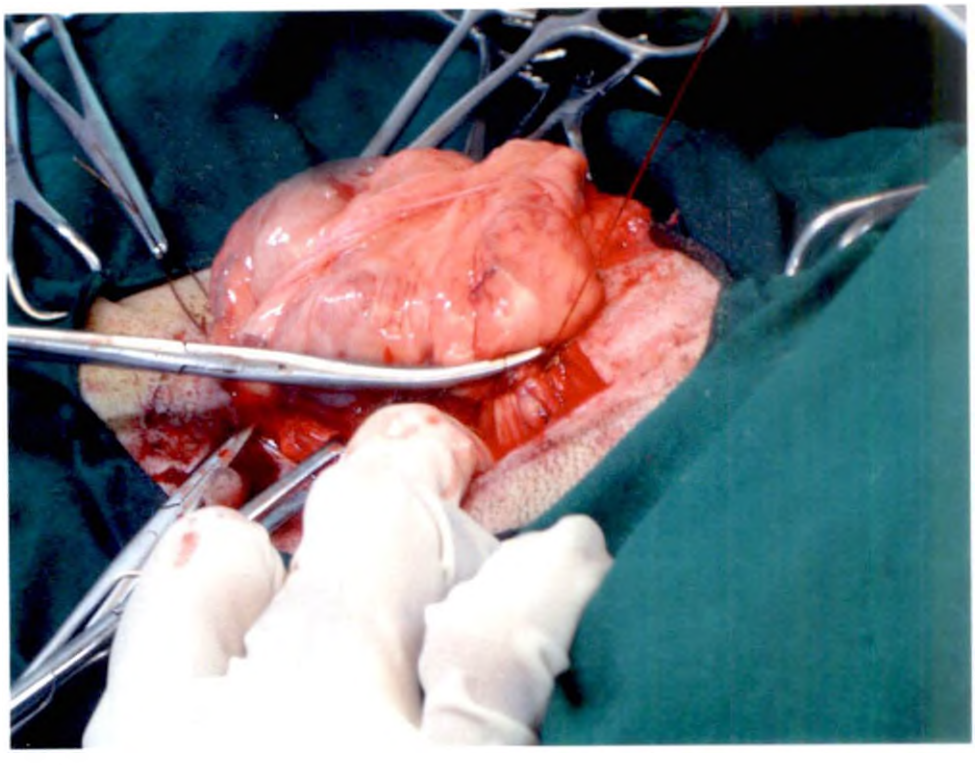

Fig.2. Circumferential ligature is being applied around the ovarian pedicle

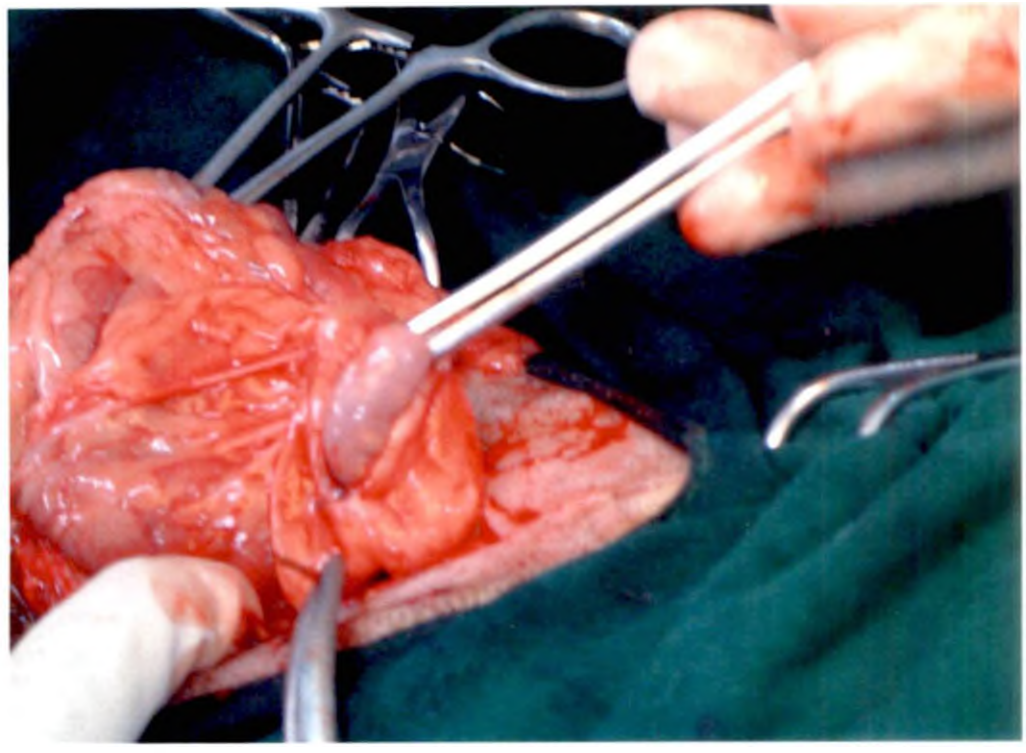

Fig.3. Opened ovarian bursa prior to dissection of the ovary

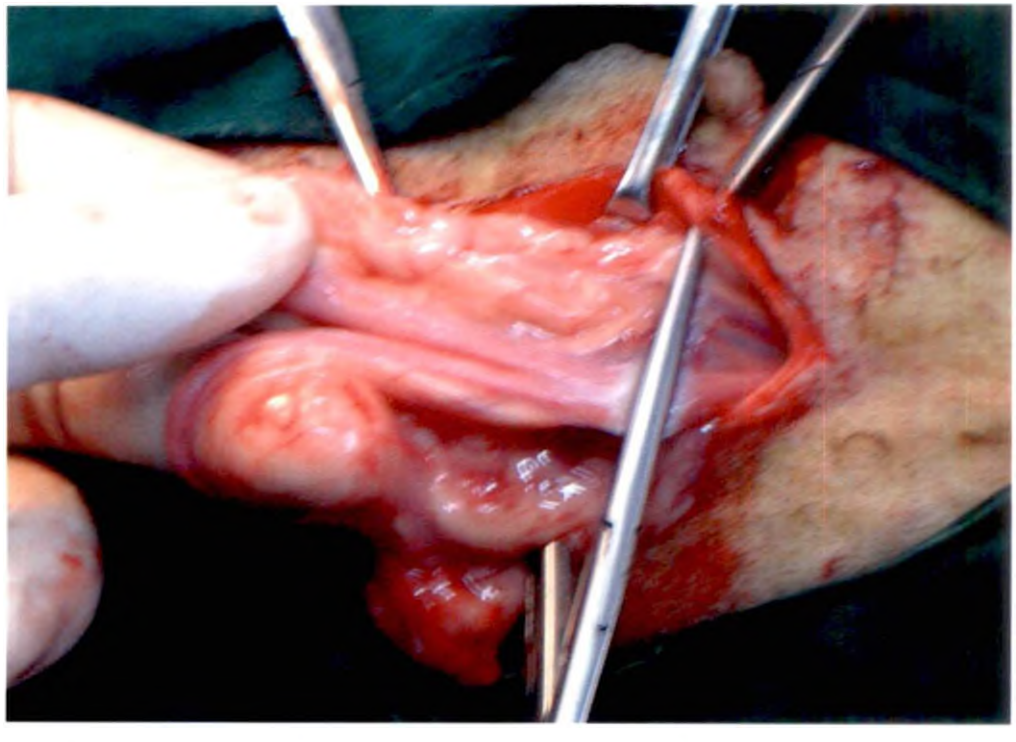

Fig. 4. Clamp being placed on the uterine body just cranial to the cervix

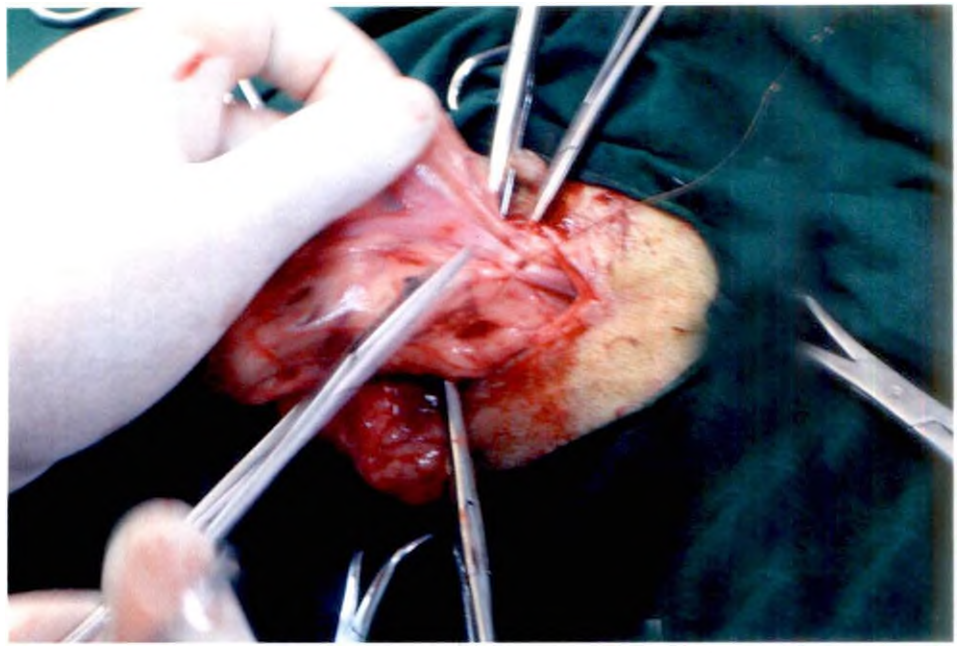

Fig. 5. Uterine arteries and uterine body are individually ligated

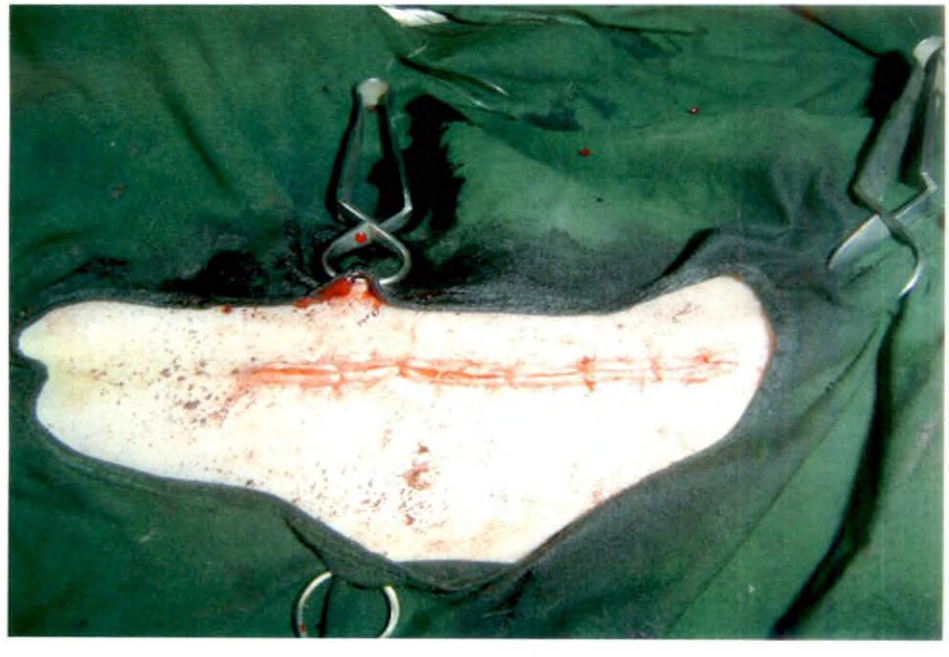

Fig. 6. Apposed skin incision

Table 1. Criteria used to score clinical appearance of wounds

Outcome	Wound score			
	0	1	2	3
Swelling (mm)	None	0-2 mm	2- 5 mm	> 5 mm
Erythema (mm)	None	0-2 mm	2- 5 mm	> 5 mm
Dehiscence (%)	None	0-20 %	20- 50 %	> 50%
Discharge	None	Serosanguinous	Purulent	

Table 2. Sedation score during postoperative period.

Sedation score	0 Fully alert	1 Faintly sedate	2 Slightly sedate	3 Mildly sedate	4 Moderately sedate	5 Very sedate
	No apparent sensory or motor deficit, appears equivalent to preanaesthesia	Capable of standing and walking, may be slightly ataxic and disoriented	Capable of standing but ataxic; easily maintains sternal recumbency,	Maintain sternal recumbency; but does not stand, this category includes dogs which struggle to get up	Will raise the head but does not maintain raised position; usually lateral recumbency	Relative non responsive; Unable to raise head

Table 3. Pain score during postoperative period.

1.	**Head and body movement:** a. Relaxed, freely moving	0
	b. Less noticeable alteration from normal	1
	c. Slightly restricted movement	2
	d. Moderate restriction of movement	3
	e. Severe restriction of movement	4
	f. May not move at all.	5
2.	**Mental status:** a. Submissive	0
	b. Overtly friendly	1
	c. Wary	2
	d. Aggressive	3
3.	**Activity:** a. Sleeping or semi conscious	0
	b. Resting comfortably, moving freely, respond to calm voice and tail wagging	1
	c. Some positional changes, resting calmly, respond to calm voice	2
	d. Vocalizing, frequent positional changes, some thrashing movements	3
	e. Defaecation, rolling, does not respond to calm voice, severe vocalization.	4

Results

4. RESULTS

Group I

The study was carried out in six clinically healthy non descript bitches presented to the clinic to undergo panhysterectomy.

The data pertaining to age, body weight period of fasting,anaesthetics used, induction time, duration of anaesthesia, duration of surgery and recovery period are presented in Table 4. The average age (year) of animals was 2.08 ± 0.29 and average body weight (kilogram) was 15.16 ± 3.50

4.1 PREOPERATIVE CONSIDERATION

Behavioural signs of preoperative stress like vocalization, defaecation, urination, struggling to escape and panting were noted in all the animals up to the period of anaesthetic induction.

4.2 ANAESTHESIA

The data are given in Table.4.

Animals were premedicated with atropine sulphate (0.69 ± 0.12 mg) and xylazine hydrochloride (24.00 ± 4.82 mg) intramuscularly. Xylazine hydrochloride (15.17 ± 1.29 mg) and ketamine hydrochloride (37.91 ± 3.25 mg) combination was administered intravenously to effect anaesthesia.

The average duration for the time of induction, anaesthesia and recovery were 2.08 ± 0.20, 49.16 ± 1.52 and 85.00 ± 3.41 min. respectively. The anaesthesia was satisfactory for the surgical procedure.

4.3 SURGICAL PROCEDURE

The average duration of surgical procedure was 41.66 ± 2.10 min. No complications were observed during the surgery (Table 4).

4.4 MAIN ITEMS OF OBSERVATION

4.4.1 Physiological Parameters

The data pertaining to physiological parameters are presented in Table 5.

Rectal temperature (°C) was 39.03 ± 0.71 before surgery, 38.08 ± 0.14 immediately after surgery, 38.80 ± 0.16 at 24th hr, 39.00 ± 0.06 on 4th day and 38.93 ± 0.09 on eighth day respectively. There was significant ($P<0.05$) decrease in rectal temperature immediately after surgery compared to preoperative value and there after appreciable rise to near normal was observed by 4th postoperative day.

Pulse rate (per min) was 81.67 ± 2.20 before surgery, 78.33 ± 2.21 immediately after surgery, 82.67 ± 2.25 at 24th hr, 82.00 ± 1.67 on 4th day and 82.00 ± 1.67 on 8th day postoperatively. Pulse rate remained in normal range during the period of observation.

Respiration rate (per min) was 35.67 ± 11.70 before surgery, 17.00 ± 1.91 immediately after surgery, 20.66 ± 2.10 at 24th hr, 22.00 ± 2.18 on 4th day and 24.33 ± 3.37 on 8th day postoperatively. There was significant ($P<0.05$) decrease in respiration rate immediately after surgery compared to preoperative value. The respiration rate showed appreciable increase during the period of observation.

Colour of mucous membrane and Capillary refill time (sec) revealed no significant changes during the period of observation.

4.4.2 Haematological Parameters

The data on haematological parameters are presented in Table 6.

Differential leucocyte count

The mean neutrophil count (per cent) was 63.83 ± 1.77 before surgery, 65.50±1.64 immediately after surgery, 75.83 ± 0.79 at 24th hr, 71.16 ± 1.35 on 4th

day and 71.67 ± 1.20 on 8th day postoperatively. There was significant (P<0.05) increase in neutrophil count at 24th hour, on 4th day and 8th day postoperatively.

The mean lymphocyte count (per cent) was 33.16 ± 2.24 before surgery, 32.67 ± 0.66 immediately after surgery, 23.5 ± 0.08 at 24th hr, 27.0 ± 0.51 on 4th day and 28.0 ± 1.09 on 8th day postoperatively. There was significant (P<0.05) fall in lymphocyte count at 24th hour followed by rise on 4th day and 8th day postoperatively. The variations in lympocyte count were within the normal range.

The mean monocyte count (per cent) and the mean eosinophil count (per cent) showed no significant variation throughout the period of observation and were within the normal range.

The mean white blood cell count (10^3/cu.mm) was 10.56 ± 0.71 before surgery, 7.02±0.80 immediately after surgery, 13.59 ± 0.71 at 24th hr, 12.21 ± 0.62 on 4th day and 11.40 ± 0.78 on 8th day postoperatively. There was significant (P<0.05) decrease in white blood cell count immediately after surgery, followed by significant (P<0.05) increase at 24th hour and 4th day postoperatively. The white blood cell count reached near the presurgical value by 8th postoperative day and the variations observed during postoperative period were within the normal range.

The mean haemoglobin concentration (g/dl) was 13.23 ± 0.59 before surgery, 12.66±1.43 immediately after surgery, 13.67 ± 0.96 at 24th hr, 13.11 ± 0.73 on 4th day and 13.40 ± 0.81 on 8th day postoperatively. There was significant (P<0.05) decrease in haemoglobin concentration immediately after surgery and there after it showed rise towards normal level. The variations in haemoglobin concentrations were within the normal range.

The mean volume of packed red cells (per cent) was 41.50 ± 3.04 before surgery, 40.50 ± 3.35 immediately after surgery, 42.00 ± 4.36 at 24th hr, 42.00 ± 4.36 on 4th day and 40.83 ± 1.77 on 8th day postoperatively. There was decrease in volume

of packed red cells immediately after surgery, there after an increase was noted at 24th hour and on 4th day postoperatively and reached near the preoperative value by 8th postoperative day. The values were within normal range throughout the period of observation.

4.4.3 Biochemical Parameters

The data pertaining to biochemical parameters are presented in Table 7 and 8.

The cortisol concentration (μg/dl) was 3.50 ± 0.34 before surgery, 10.48 ± 0.74 immediately after surgery and 2.83 ± 0.61 at 24th hour postoperatively. There and decreased to near normal range by 24th hour postoperatively. was significant ($P<0.05$) increase in cortisol concentration immediately after surgery

The glucose concentration (mg/dl) was 72.87 ± .90 before surgery, 163.48 ± 11.11immediately after surgery, 73.49 ± 0.93 at 24th hr, 78.43 ± 2.57 on 4th day and 83.33 ± 3.42 on 8th day postoperatively. There was significant ($P<0.05$) increase in glucose concentration immediately after surgery and it showed a fall towards preoperative level by 24th hour. There after marginal but significant ($P<0.05$) increase in glucose concentration was observed on 4th day and 8th day postoperatively.

The total protein content (g/dl) was 7.05 ± 0.38 before surgery, 6.71 ± 0.37 immediately after surgery, 6.90 ± 0.37 at 24th hr, 6.81 ± 0.32 on 4th day and 6.80 ± 0.31 on 8th day postoperatively. There was a significant ($P<0.05$) decrease in total protein concentration immediately after surgery and there after it showed an increase on 24th hour and remained in the normal range throughout the period of observation.

The albumin content (g/dl) was 3.40 ± 0.41 before surgery, 3.30 ± 0.77 immediately after surgery, 3.20 ± 0.33 at 24th hr, 3.13 ± 0.34 on 4th day and 3.08 ±

0.39 on 8th day postoperatively. The albumin content remained in normal range throughout the period of observation and the variations were marginal.

The globulin content (g/dl) was 3.61 ± 0.09 before surgery, 3.40 ± 0.17immediately after surgery, 3.70 ± 0.14 at 24th hr, 3.68 ± 0.10 on 4th day and 3.76 ± 0.15 on 8th day postoperatively. The globulin content remained in the normal range throughout the period of observation.

The blood urea nitrogen level (mg/dl) was 9.67 ± 0.69 before surgery, 11.49 ± 0.88 immediately after surgery, 14.11 ± 1.44 at 24th hr, 11.54 ± 0.72 on 4th day and 10.20 ± 0.46 on 8th day postoperatively. There was significant ($P<0.05$) increase in blood urea nitrogen level immediately after surgery, 24th hour and 4th day postoperatively. It remained in normal range throughout the period of observation and reached near preoperative level by eighth postoperative day.

The sodium concentration (mEq/l) was 146.40 ± 0.51 before surgery, 145.10 ± 0.65 immediately after surgery, 144.30 ± 0.61 at 24th hr, 145.60 ± 0.48 on 4th day and 145.80 ± 0.59 on 8th day postoperatively. There was marginal decrease in sodium concentration immediately after surgery and 24th hour, there after the level maintained within the normal range.

The potassium concentration (mEq/l) was 4.22 ± 0.11 before surgery, 4.48 ± 0.11 immediately after surgery, 4.32 ± 0.08 at 24th hr, 4.48 ± 0.09 on 4th day and 4.47 ± 0.05 on 8th day postoperatively. The variations were marginal and the potassium concentration remained in the normal range throughout the period of observation.

4.5 EVALUATION OF WOUND HEALING

4.5.1 Clinical Assessment of Wound

The data on wound scoring are presented in Table 9.

Moderate swelling on the wound edges, hyperalgesia of the wound and inflammatory oedema of the surgical site was observed at 24th hour postoperatively. Erythema on the wound margin along with serosanguinous discharge at the surgical site was also noted in all the dogs. This inflammatory reaction gradually subsided by three to four days and completely disappeared by 8th postoperative day. Skin wounds showed normal healing and the sutures were removed by 8th day postoperatively. Wound dehiscence was observed in one animal (Animal no. 5) that mutilated the suture line and wound was freshened and resutured. The sutures were removed after healing of the wound on 8th day.

4.5.2 Histopathology

Mild to moderate degree of infiltration with inflammatory cells, primarily of mononuclear cells could be observed on 4th day (Fig.7). Regenerative surface epithelium could be noted along with proliferative fibroblast and capillaries. Proliferation of collagen fibers with swollen appearance could be observed. On 8th day regenerated surface epithelium along with reduced infiltration of inflammatory cells, proliferated collagen bundle and fibroplasia could be observed (Fig.8).

4.5.3 Ultrasound scanning of the Wound Site

The distance measured from epidermis to the acoustic interface of subcutis was 1.21 cm on 4th day (Fig.9) and it was reduced to 0.83 cm on 8th day postoperatively (Fig.10).

4.6 ASSESSMENT OF PATIENT DURING POSTOPERATIVE PERIOD

The data pertaining to assessment of animals during postoperative period are presented in Table 10. Mean sedation score and mean pain score observed during postoperative period are presented in Table 11.

4.6.1 Activity and Alertness clearly decreased up to 6 hours and decreased to some extent by 12th hour postoperatively and started increasing to some extent by 24th hour, then clearly increased from 2nd day and reached normal by 3rd day.

4.6.2 Feeding Habits clearly decreased on day 1, decreased to some extent on day 2 then clearly increased from day 3 and reached normal by day 4 postoperatively.

4.6.3 Behavioural Changes

Lateral recumbency clearly increased up to 1st hour and an increase to some extent was noted up to 12th hour. The animals assumed sternal recumbency by 24th hour post operatively.

Sternal recumbency clearly decreased up to 3rd hour and decreased to some extent up to 12th hour and increased to some extent at 24th hour, and clearly increased on 2nd and 3rd day postoperatively.

Sleeping positional changes started increasing from 3rd hour, clearly increased up to 24th hour and reduced by 2nd and 3rd day postoperatively.

Self-grooming clearly decreased up to 12th hour and decreased to some extent up to 24th hour and increased to some extent on 2nd day and clearly increased on 3rd day postoperatively.

Tail wagging clearly decreased up to 12th hour and increased to some extent up to 24th hour and clearly increased on 2nd and 3rd day postoperatively.

Standing and walking clearly decreased up to 3rd hour and decreased to some extent up to 6th hour and increased to some extent at 24th hour and reached normal by 2nd and 3rd day postoperatively

4.6.4 Clinical well being

Clinical well being clearly decreased at 24th hour, decreased to some extent on day 2 then increased to some extent on 3rd day postoperatively.

4.6.5 Sedation Score

Animals were very sedated, relatively nonresponsive and unable to raise head during the 1st postoperative hour and by 3rd hour started raising the head but could not maintain raised position and were in moderately sedated state. Lateral recumbency maintained at 12th hour, this mildly sedated state reduced by 24th hour at which they maintained sternal recumbency. During the faintly sedated state, animals were capable of standing and walking, but slightly ataxic and disoriented. They reached fully alert condition by 3rd postoperative day.

4.6.6 Pain Score

The animals were feeling severe pain during 12 hours from immediate postoperative period showing severe to moderate restriction of movement, wary mental status and frequent positional changes. By 24th hour, slight restriction of body movements, wary mental status and some positional changes suggesting that animals were in moderate pain. Animals started greeting behaviour, resting comfortably, and mental status overtly friendly during 2nd and 3rd postoperative days.

Table 4. Observations on age, body weight, period of fasting, premedicants, anaesthetics used, induction time, duration of anaesthesia, duration of surgery and recovery period in Group I animals (Mean ± S.E) (n= 6)

Parameters	
Age (years)	2.08 ± 0.29
Body weight (kg)	15.16 ± 3.5
Fasting time (Hours)	13.90 ± 0.57
Premedicants: Atropine sulphate (mg)	0.69 ± 0.12
Xylazine hydrochloride (mg)	24.00 ± 4.82
Anaesthetics: Xylazine hydrochloride (mg)	15.17 ± 1.29
Ketamine hydrochoride (mg)	37.91 ± 3.25
Induction time (min.)	2.08 ± 0.20
Duration of anaesthesia (min.)	49.16 ± 1.52
Duration of surgery (min.)	41.66 ± 2.10
Recovery period (min.)	85.00 ± 3.41

Table 5. Observations on physiological parameters in Group I animals (Mean±SE) (n=6)

Parameters	Preoperative	Postoperative			
		Immediate	24th hour	4th day	8th day
Rectal temperature(^{0} C)	39.03 ± 0.71	38.08 ± 0.14*	38.80 ± 0.16	39.00 ± 0.06	38.93 ± 0.09
Pulse rate (Per min)	81.67 ± 2.20	78.33 ± 2.21	82.67 ± 2.25	82.00 ± 1.67	82.00 ± 1.67
Respiration rate (Per min)	35.67 ± 11.70	17.00± 1.91*	20.66 ± 2.10	22.00 ± 2.18	24.33 ± 3.37
Colour of mucous membrane	Pale roseate	Pale roseate	Pale roseate	Pale roseate	Pale roseate
Capillary refill time (Sec)	< 2	< 2	< 2	< 2	< 2

* Significant at 5% level with preoperative value ($P<0.05$)

Table 6. Observations on haematological parameters in Group I animals. (Mean±SE) (n=6)

Parameters	Preoperative	Postoperative			
		Immediate	24th hour	4th day	8th day
Neutrophils (%)	63.83 ± 1.77	65.50 ± 1.64	75.83 ± 0.79*	71.16 ± 1.35*	71.67 ± 1.20*
Lymphocytes (%)	33.16 ± 2.24	32.67 ± 0.66	23.5 ± 0.08*	27.0 ± 0.51*	28.0 ± 1.09*
Monocytes (%)	1.5 ± 0.91	1.1 ± 0.67	0.56 ± 0.33	0.33 ± 0.25	0.27 ± 0.16
Eosinophils (%)	0.33 ± 0.33	0.5 ± 0.33	0.33 ± 0.20	0.33 ± 0.20	0.16 ± 0.16
Basophils (%)	0.00	0.00	0.00	0.00	0.00
White blood cell count (10^3/cu.mm)	10.56 ± 0.71	7.02 ± 0.80*	13.59 ± 0.71*	12.21 ± 0.62*	11.40 ± 0.78
Haemoglobin (g/dl)	13.23 ± 0.59	12.66 ± 1.43*	13.67 ± 0.96	13.11 ± 0.73	13.4 ± 0.81
Volume of packed red cells (%)	41.50 ± 3.04	40.50 ± 3.35	42.00 ± 4.36	42.00 ± 4.36	40.83 ± 1.77

* Significant at 5% level with preoperative value ($P<0.05$)

Table 7. Observations on cortisol concentration in Group I animals (Mean±SE) (n=6)

Parameter	Preoperative	Postoperative	
		Immediate	24th hour
Cortisol (µg/dl)	3.50 ± 0.34	10.48 ± 0.74*	2.83 ± 0.61

* Significant at 5% level with preoperative value (P<0.05)

Table-8. Observations on biochemical parameters in Group I animals (Mean±SE) (n=6)

Parameters	Preoperative	Postoperative			
		Immediate	24th hour	4th day	8th day
Glucose (mg/dl)	72.87 ± 0.90	163.48 ± 11.11*	73.49 ± 0.93	78.43± 2.57*	83.33±3.42*
Total protein(g/dl)	7.05 ± 0.38	6.71 ± 0.37*	6.90 ± 0.37	6.81 ± 0.32	6.80 ± 0.31
Albumin (g/dl)	3.40 ± 0.41	3.30 ± 0.77	3.20 ± 0.33	3.13 ± 0.34	3.08 ± 0.39
Globulin (g/dl)	3.61± 0.09	3.40 ± 0.17	3.70 ±0.14	3.68 ± 0.10	3.76 ± 0.15
Blood urea nitrogen(mg/dl)	9.67 ± 0.69	11.49 ± 0.88*	14.11 ± 1.44*	11.54 ±0.72*	10.20 ± 0.46
Sodium (mEq/l)	146.40 ± 0.51	145.1 ± 0.65	144.3 ± 0.61	145.60 ± 0.48	145.8 ± 0.59
Potassium (mEq/l)	4.22 ± 0.11	4.48 ± 0.11	4.32 ± 0.08	4.48 ± 0.09	4.47 ± 0.05

* Significant at 5% level with preoperative value (P<0.05)

Table 9. Observations on clinical appearance of wound (mean wound scores) in Group I animals.

Outcome	Postoperative period		
	24^{th} hour	4^{th} day	8^{th} day
Swelling (mm) Wound edges thicker than surrounding skin	2-5 mm (2.0)	0-2 mm (1.0)	None (0)
Erythema (mm) Distance from wound margin	0-2 mm (1.0)	(0.5)	None (0)
Dehiscence (% of suture line)	None (0)	None (0)	None (0)
Discharge	Serosanguinous (1.0)	(0.5)	None (0)

Table 10. Observation on assessment during postoperative period in Group I animals (n=6)

Parameters	Score							
	0 hr	1 hr	3hr	6hr	12 hr	24 hr	2 d	3d
1. Activity and alertness	-2	-2	-2	-2	-1	+1	+2	+2
2. Feeding habits	-2	-2	-2	-2	-2	-1	+1	+2
3.Behavioural changes								
a. Lateral recumbency	+2	+2	+1	+1	+1	-1	-2	-2
b. Sternal recumbency	-2	-2	-2	-1	-1	+1	+2	+2
c. Sleeping positional changes	-1	-1	+1	+2	+2	+2	+1	-1
d. Self grooming	-2	-2	-2	-2	-2	-1	+1	+2
e. Tail wagging	-2	-2	-2	-2	-2	+1	+2	+2
f. Standing and walking	-2	-2	-2	-1	+1	+1	+2	+2
4. Clinical well being	-2	-2	-2	-2	-2	-2	-1	+1

Table 11. Observations on mean sedation score and mean pain score during postoperative period in Group I animals (n=6)

Items	0 hr	1 hr	3hr	6hr	12 hr	24 hr	2 d	3d
Sedation score	4.8	4.7	4.0	3.2	2.5	1.0	0.3	-
Pain sore	10	9.0	8.2	7.5	6.7	4.7	2.8	1

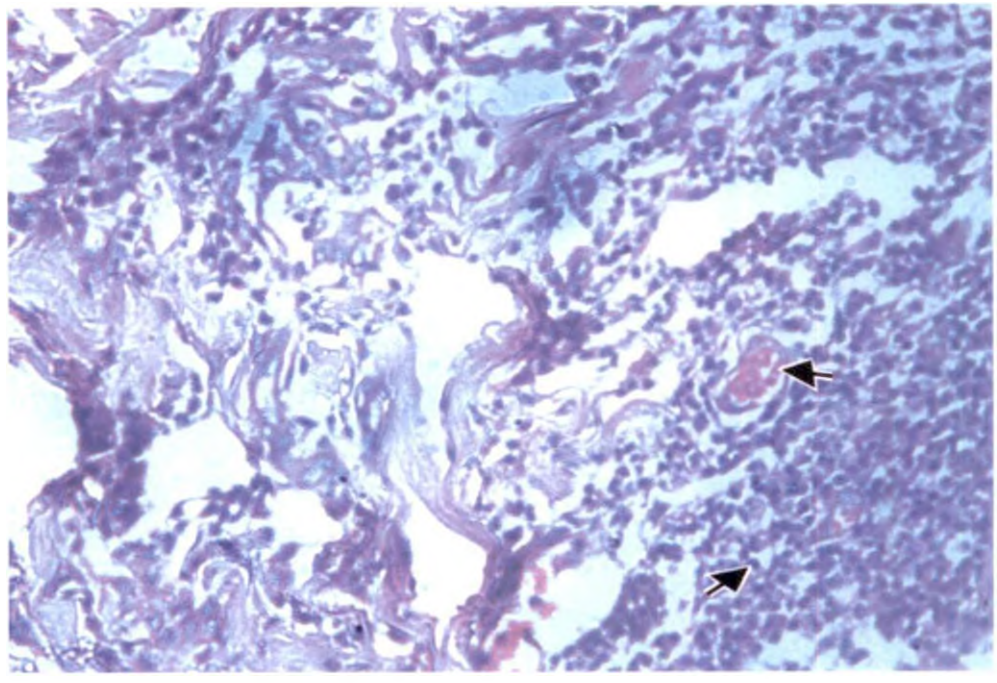

Fig. 7. Photomicrograph of surgical wound on 4th day showing infiltration of mononuclear cells along with capillary proliferation (H & E x 400)

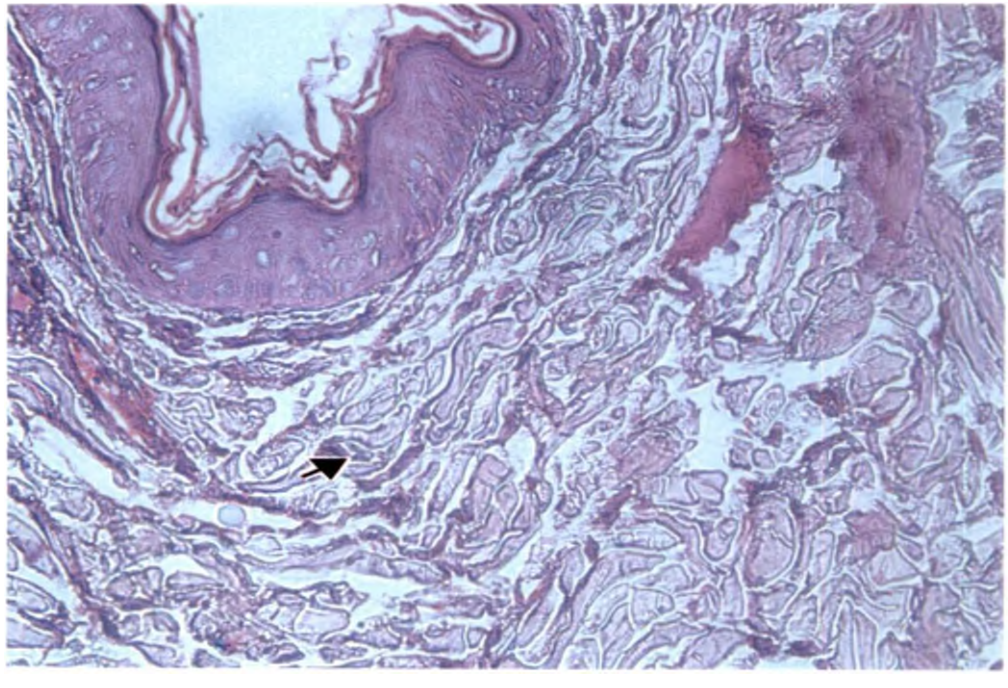

Fig. 8. Photomicrograph of surgical wound on 8th day showing regenerated surface epithelium along with proliferated collagen bundles (H & E x 400)

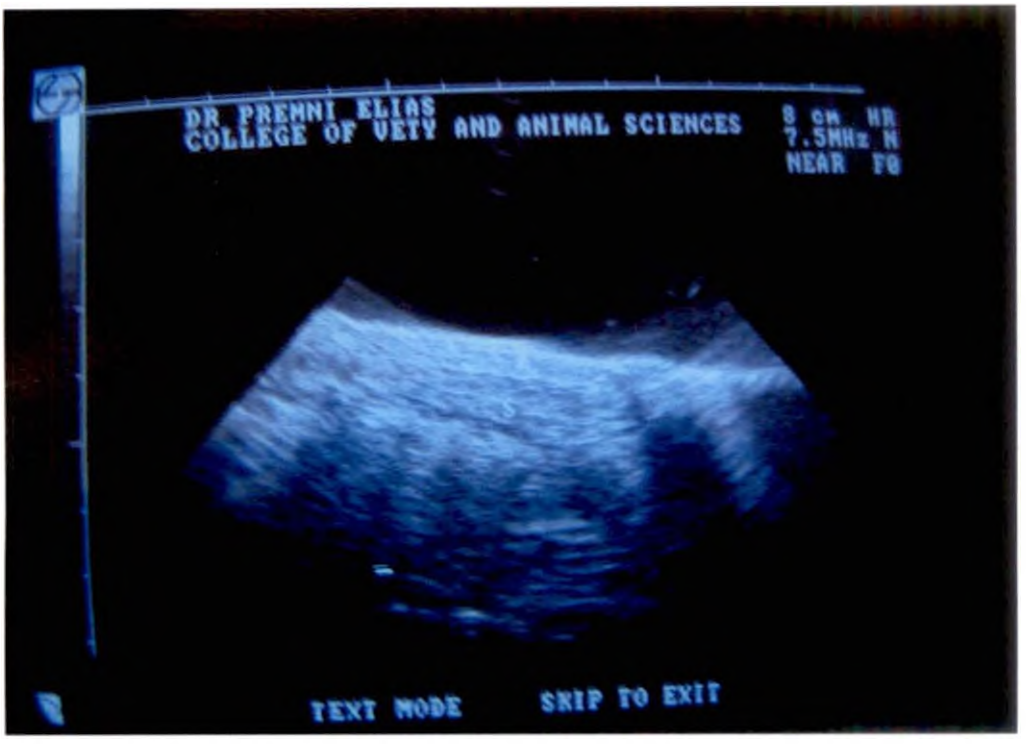

Fig.9. Representative ultrasonogram of the surgical wound site on 4th day in group I showing distance between epidermis and acoustic interface of subcutis (1.21cm)

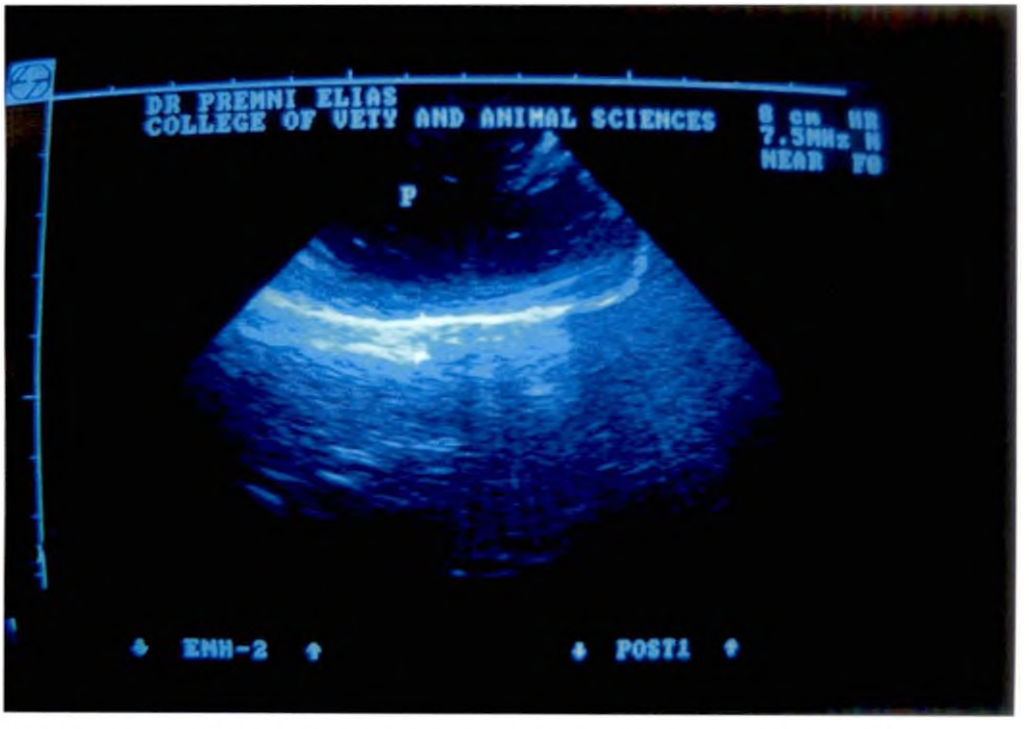

Fig.10. Representative ultrasonogram of the surgical wound site on 8th day in group I showing distance between epidermis and acoustic interface of subcutis (0.83 cm)

Group II

The study was carried out in six clinically healthy non descript bitches presented to the clinic to undergo panhysterectomy.

The data pertaining to age, body weight and period of fasting, premedicants, anaesthetics used, induction time, duration of anaesthesia, duration of surgery and recovery from anaesthesia are presented in Table.12. The average age (year) of animals was 1.65 ± 0.26 and average body weight (kilogram) was 13.33 ± 1.49

4.1 PREOPERATIVE CONSIDERATION

Behavioural signs of preoperative stress like vocalization, defaecation, urination, struggling to escape and panting were observed in all the animals up to the period of anaesthetic induction.

4.2 ANAESTHESIA

The data are presented in Table 12.

Animals were premedicated with atropine sulphate (0.57 ± 0.06 mg) and xylazine hydrochloride (19.67 ± 2.15 mg) intramuscularly. Xylazine hydrochloride (14.83 ± 1.91 mg) and ketamine hydrochloride (37.08 ± 4.80 mg) combination was administered intravenously to effect anaesthesia.

The average duration for the time of induction, anaesthesia and recovery were 2.16 ± 0.16, 40.00 ± 1.29 and 45.83 ± 1.29 min. respectively. The anaesthesia was satisfactory for the surgical procedure.

4.3 SURGICAL PROCEDURE

The average duration of surgical procedure was 41.66 ± 1.66 min. (Table 12). No complications were observed during the surgery.

4.4 MAIN ITEMS OF OBSERVATION

4.4.1 Physiological Parameters

The data pertaining to physiological parameters are presented in Table 13.

Rectal temperature (°C) was 38.92 ± 0.53 before surgery, 38.01 ± 0.11 immediately after surgery, 38.67 ± 0.10 at 24th hr, 38.91 ± 0.09 on 4th day and 38.86 ± 0.04 on eighth day respectively. There was significant ($P<0.05$) decrease in rectal temperature immediately after surgery, there after an increase to reach preoperative value was observed during postoperative period.

Pulse rate (per min) was 88.33 ± 3.44 before surgery, 80.0 ± 1.78 immediately after surgery, 85.0 ± 1.59 at 24th hr, 85.67±2.55 on 4th day and 83.33 ± 2.40 on 8th day postoperatively. There was significant ($P<0.05$) fall in pulse rate immediately after surgery and there after it showed a rise and remained in normal range during the period of observation.

Respiration rate (per min) was 27.67 ± 11.70 before surgery, 20.67 ± 1.60 immediately after surgery, 26.33 ± 3.47 at 24th hr, 26.67 ± 1.82 on 4th day and 24.0 ± 2.06 on 8th day postoperatively. There was significant ($P<0.05$) decrease in respiration rate immediately after surgery followed by an increase towards normal by 24th hour and there after variations were marginal.

Colour of mucous membrane and Capillary refill time (sec) revealed no significant changes during the period of observation.

4.4.2 Haematological Parameters

The data on haematological parameters are presented in Table 14.

Differential leucocyte count

The mean neutrophil count (per cent) was 68.67 ± 0.61 before surgery, 70.16 ± 0.83 immediately after surgery, 76.67 ± 0.61 at 24th hr, 73.5 ± 0.62 on 4th day and 71.16 ± 1.40 on 8th day postoperatively. There was a significant ($P<0.05$) increase in neutrophil count at 24th hour and on4th day postoperatively. The neutrophil count reached near normal by eighth day postoperatively.

The mean lymphocyte count (per cent) was 30.67 ± 1.06 before surgery, 29.00 ± 1.51 immediately after surgery, 23.0 ± 0.36 at 24th hr, 26.16 ± 0.65 on 4th day and 28.66 ± 1.47 on 8th day postoperatively. There was significant ($P<0.05$) decrease in lymphocyte count at 24th hour and on 4th day. The lymphocyte count reached preoperative value by 4th day and the variations observed were within normal range.

The mean monocyte count (per cent) and the mean eosinophil count (per cent) showed no significant variation throughout the period of observation and were within the normal range.

The mean white blood cell count (10^3/cu.mm) was 10.48 ± 0.83 before surgery, 7.23 ± 0.40 immediately after surgery, 11.95 ± 0.62 at 24th hr, 10.58 ± 0.75 on 4th day and 10.68 ± 0.61 on 8th day postoperatively. There was significant ($P<0.05$) fall in white blood cell count immediately after surgery followed by significant ($P<0.05$) rise at 24th hour postoperatively. The white blood cell count reached preoperative value by eighth postoperative day and the variations observed during postoperative period were within normal range.

The mean haemoglobin concentration (g/dl) was 12.44 ± 0.73 before surgery, 11.30 ± 0.83 immediately after surgery, 12.15 ± 0.75 at 24th hr, 11.97 ± 0.93 on 4th day and 12.27 ± 0.73 on 8th day postoperatively. There was significant ($P<0.05$) decrease in haemoglobin concentration immediately after surgery followed by

increase from 24th hour onwards. The variations in haemoglobin concentration from 24th postoperative hour were within the normal range and marginal.

The mean volume of packed red cells (per cent) was 35.67 ± 2.65 before surgery, 33.67 ± 2.33 immediately after surgery, 33.33 ± 1.80 at 24th hr, 33.5 ± 2.76 on 4th day and 33.5 ± 2.18 on 8th day postoperatively. There was significant ($P<0.05$) decrease in volume of packed red cells immediately after surgery, there after an increase was noted at 24th hour and on 4th day postoperatively. The values remained within the normal range throughout the period of observation.

4.4.3 Biochemical Parameters

The data pertaining to biochemical parameters are presented in Table 15 and 16.

The cortisol concentration (μg/dl) was 3.41 ± 0.37 before dextrose infusion, 3.60 ± 0.39 before surgery, 8.98 ± 0.37 immediately after surgery and 2.96 ± 0.58 at 24th hour postoperatively. There was significant ($P<0.05$) increase in cortisol concentration immediately after surgery and decreased to near normal range by 24th hour postoperatively.

The glucose concentration (mg/dl) was 74.69 ± 1.08 before surgery, 129.86 ± 3.55 immediately after surgery, 84.79 ± 4.45 at 24th hr, 84.41 ± 3.90 on 4th day and 84.68 ± 3.47 on 8th day postoperatively. There was increase in glucose concentration immediately after surgery and reached normal range by 24th hour postoperatively. The values immediately after surgery, at 24th hour and on 4th day postoperatively were significant ($P<0.05$).

The total protein content (g/dl) was 6.92 ± 0.38 before surgery, 6.58 ± 0.45 immediately after surgery, 6.62 ± 0.46 at 24th hr, 6.81 ± 0.40 on 4th day and 6.87 ± 0.44 on 8th day postoperatively. There was significant ($P<0.05$) decrease in total protein concentration immediately after surgery and there after increased by 24th

hour and remained elevated within the normal range throughout the period of observation.

The albumin content (g/dl) was 3.11 ± 0.32 before surgery, 3.01 ± 0.29 immediately after surgery, 3.18 ± 0.34 at 24th hr, 3.33 ± 0.26 on 4th day and 3.41 ± 0.27 on 8th day postoperatively. The albumin content remained in the normal range throughout the period of observation and the variations were marginal.

The globulin content (g/dl) was 3.70 ± 0.22 before surgery, 3.56 ± 0.29 immediately after surgery, 3.43 ± 0.25 at 24th hr, 3.47 ± 0.22 on 4th day and 3.45 ± 0.28 on 8th day postoperatively. The variations in globulin content were marginal and remained in the normal range throughout the period of observation.

The blood urea nitrogen level (mg/dl) was 10.51 ± 0.58 before surgery, 11.51 ± 0.67 immediately after surgery, 12.65 ± 0.44 at 24th hr, 10.65 ± 0.30 on 4th day and 10.28 ± 0.24 on 8th day postoperatively. There was significant ($P<0.05$) rise in blood urea nitrogen level immediately after surgery and by 24th hour. Blood urea nitrogen level decreased by 4th day and reached near preoperative value by 8th postoperative day.

The sodium concentration (mEq/l) was 145.60 ± 0.59 before surgery, 143.80 ± 0.70 immediately after surgery, 144.23 ± 0.35 at 24th hr, 144.80 ± 0.42 on 4th day and 144.90 ± 0.52 on 8th day postoperatively. The variations in the sodium concentration were within normal range throughout the period of observation.

The potassium concentration (mEq/l) was 4.39 ± 0.09 before surgery, 4.41 ± 0.11 immediately after surgery, 4.31 ± 0.08 at 24th hr, 4.43 ± 0.07 on 4th day and 4.32 ± 0.12 on 8th day postoperatively. The potassium concentration remained in normal range throughout the period of observation.

4.5 EVALUATION OF WOUND HEALING

The data on wound scoring are presented in Table 17.

4.5.1 Clinical Assessment of Wounds

Moderate swelling on the wound edges, erythema on the wound margin along with serosanguinous discharge at the surgical site was observed at 24th hour postoperatively. Moderate pain and inflammatory oedema of the surgical site was also noted in all the dogs. No wound dehiscence was noted throughout the period of observation. The inflammatory reaction and serosanguinous discharge gradually reduced by three to four days and completely disappeared by 8th postoperative day. Skin wounds showed normal healing and the sutures were removed on 8th day postoperatively.

4.5.2 Histopathology

Regenerative surface epithelium could be observed on 4th day along with proliferative fibroblast and capillaries. Mild to moderate degree of infiltration with inflammatory cells could be observed, primarily of mononuclear cells (Fig.11). Small amount of fibroplasia representing new collagen was apparent. On 8th day capillaries and proliferation of collagen were more compared to that of day 4.Regenerated surface epithelium along proliferated collagen bundle and fibroplasia could be observed (Fig.12)

4.5.3 Ultrasound scanning of the wound site

The distance measured from epidermis to the acoustic interface of subcutis was 1.20 cm on 4th day (Fig.13) and the distance was reduced on 8th day to 0.81 cm (Fig.14).

4.6 ASSESSMENT OF PATIENT DURING POSTOPERATIVE PERIOD

The data pertaining to assessment of animals during postoperative period are presented in Table 18. Mean sedation score and mean pain score observed during postoperative period are presented in Table 19.

4.6.1 Activity and Alertness clearly decreased up to 1st hour and decreased to some extent by 6th hour postoperatively and started increasing to some extent by 12th hour, then clearly increased from 1st day and reached normal by 2nd day.

4.6.2 Feeding Habits decreased to some extent on day 1, then clearly increased from day 2 and reached normal by day 3 postoperatively.

4.6.3 Behavioural Changes

Lateral recumbency increased to some extent up to 3rd hour postoperatively assumed sternal recumbency by 6th hour post operatively.

Sternal recumbency decreased to some extent up to 1st hour, increased to some extent up to 3rd hour and clearly increased from 6th hour postoperatively.

Sleeping positional changes started increasing from 1st hour, reduced from 6 to 24 hours postoperatively.

Self-grooming clearly decreased up to 12th hour and increased to some extent on 24th hour and clearly increased on 2nd and 3rd day postoperatively.

Tail wagging clearly decreased up to 1st hour and decreased to some extent on 3rd hour and increased to some extent on 12th hour and clearly increased by 24th hour postoperatively.

Standing and walking clearly decreased up to 0th hour and decreased to some extent on 3rd hour and increased to some extent on 6th hour and clearly increased and reached normal by 12th hour postoperatively.

4.6.4 Clinical well being

Clinical well being decreased to some extent on day 1, then clearly increased and reached normal by day 2 postoperatively.

4.6.5 Sedation Score

Animals were moderately sedated, able to raise the head and in lateral recumbency by the 0^{th} hour and started sternal recumbency during the 1^{st} postoperative hour. By 3^{rd} hour animals were faintly sedated, capable of standing and walking with slight ataxia and disorientation. They were fully alert by 6^{th} hour postoperatively.

4.6.6 Pain Score

Animals showed moderate pain behaviour at 3^{rd} postoperative hour, moderate restriction of movements, wary mental status, resting and some positional changes observed during this period. During 6^{th} hour animals were resting calmly, responded to voice and started greeting behaviour, and capable of standing and walking. By 12^{th} hour animals were found to be relaxed and less noticeable alteration was observed. Animals were fully alert and found to be painless during 2^{nd} and 3^{rd} day.

Table 12. Observations on age, body weight, period of fasting, premedicants, anaesthetics used, induction time, duration of anaesthesia, duration of surgery and recovery period in Group II animals (Mean ± S.E) (n= 6)

Parameters	
Age (years)	1.65 ± 0.26
Body weight (kg)	13.33 ± 1.49
Period of fasting (Hours)	13.16 ± 0.47
Premedicants: Atropine sulphate (mg)	0.57 ± 0.06
Xylazine hydrochoride (mg)	19.67 ± 2.15
Anaesthesia: Xylazine hydrochoride (mg)	14.83 ± 1.91
Ketamine hydrochloride (mg)	37.08 ± 4.80
Induction time (min.)	2.16 ± 0.16
Duration of anasthesia (min.)	40.00 ± 1.29
Duration of surgery (min.)	41.66 ± 1.66
Recovery from anaesthesia (min.)	45.83 ± 1.29

Table 13. Observations on physiological parameters in Group II animals (Mean±SE) (n=6)

Parameters	Preoperative	Postoperative			
		Immediate	24th hour	4th day	8th day
Rectal temperature(^{0}C)	38.92 ± 0.53	38.01 ± 0.11*	38.67 ± 0.10	38.91 ± 0.09	38.86 ± 0.04
Pulse rate (Per min)	88.33 ± 3.44	80.0 ± 1.78*	85.0 ± 1.59	85.67 ± 2.55	83.33 ± 2.40
Respiration rate (Per min)	27.67 ± 11.70	20.67 ± 1.60*	26.33 ± 3.47	26.67 ± 1.82	24.0 ± 2.06
Colour of mucous membrane	Pale roseate	Pale roseate	Pale roseate	Pale roseate	Pale roseate
Capillary refill time (Sec)	< 2	< 2	< 2	< 2	< 2

* Significant at 5% level with preoperative value ($P<0.05$)

Table 14. Observations on haematological parameters in Group II animals (Mean±SE) (n=6)

Parameters	Preoperative	Postoperative			
		Immediate	24th hour	4th day	8th day
Neutrophils (%)	68.67 ± 0.61	70.16 ± 0.83	76.67 ± 0.61*	73.5 ± 0.62*	71.16 ± 1.40
Lymphocytes (%)	30.67 ± 1.06	29.00 ± 1.51	23.00 ± 0.36*	26.16 ± 0.65*	28.66 ± 1.47
Monocytes (%)	0.45 ± 0.20	0.00	0.28 ± 0.16	0.27 ± 0.16	0.27± 0.16
Eosinophils (%)	0.00	0.27 ± 0.16	0.5 ± 0.21	0.27 ± 0.16	0.00
Basophils (%)	0.00	0.00	0.00	0.00	0.00
White blood cell count (10^3/cu.mm)	10.48 ± 0.83	7.23 ± 0.40*	11.95 ± 0.62*	10.58 ± 0.75	10.68 ± 0.61
Haemoglobin (g/dl)	12.44 ± 0.73	11.30 ± 0.83*	12.15 ± 0.75	11.97 ± 0.93	12.27 ± 0.73
Volume of packed red cells (%)	35.67 ± 2.65	33.67 ± 2.33*	33.33 ± 1.80	33.5 ± 2.76	33.5 ± 2.18

* Significant at 5% level with preoperative value ($P<0.05$)

Table 15. Observations on cortisol concentration in Group II animals (Mean±SE)

(n=6)

Parameter	Preoperative		Postoperative	
	Before dextrose infusion	After dextrose infusion	Immediate	24th hour
Cortisol (µg/dl)	3.41± 0.37	3.60±0.39	8.98±0.37*	2.96±0.58

* Significant at 5% level with preoperative value (P<0.05)

Table 16. Observations on biochemical parameters in Group II animals (Mean±SE)

(n=6)

Parameters	Preoperative	Postoperative			
		Immediate	24th hour	4th day	8th day
Glucose (mg/dl)	74.69 ± 1.08	129.86± 3.55*	84.79 ± 4.45*	84.41 ± 3.9*	84.68 ± 3.47*
Total protein(g/dl)	6.92 ± 0.38	6.58 ± 0.45*	6.62 ± 0.46	6.81 ± 0.40	6.87 ± 0.44
Albumin (g/dl)	3.11 ± 0.32	3.01 ± 0.29	3.18 ± 0.34	3.33 ± 0.26	3.41 ± 0.27
Globulin (g/dl)	3.70 ± 0.22	3.56 ± 0.29	3.43 ± 0.25	3.47 ± 0.22	3.45 ± 0.28
Blood urea nitrogen(mg/dl)	10.51 ± 0.58	11.51 ± 0.67*	12.65 ± 0.44*	10.65± 0.30	10.28 ± 0.24
Sodium (mEq/l)	145.6 ± 0.59	143.8 ± 0.70	144.23± 0.35	144.8 ± 0.42	144.9 ± 0.52
Potassium (mEq/l)	4.39 ± 0.09	4.41 ± 0.11	4.31± 0.08	4.43 ± 0.07	4.32 ± 0.12

* Significant at 5% level with preoperative value (P<0.05)

Table 17. Observations on clinical appearance of wound (mean wound scores) in Group II animals.

Outcome	Postoperative period		
	24^{th} hour	4^{th} day	8^{th} day
Swelling (mm) Wound edges thicker than surrounding skin	(1.5)	0-2 mm (1.0)	None (0)
Erythema (mm) Distance from wound margin	0-2 mm (1.0)	(0.5)	None (0)
Dehiscence (% of suture line)	None (0)	None (0)	None (0)
Discharge	Serosanguinous (1.0)	(0.5)	None (0)

Table 18. Observation on assessment during postoperative period in Group II animals (n=6)

Parameters	Score							
	0 hr	1 hr	3hr	6hr	12 hr	24 hr	2 d	3d
1. Activity and alertness	-2	-2	-2	-1	+1	+2	+2	+2
2. Feeding habits	-2	-2	-2	-2	+1	+1	+2	+2
3.Behavioural changes								
a. Lateral recumbency	+1	+1	+1	-1	-2	-2	-2	-2
b. Sternal recumbency	-2	-1	+1	+2	+2	+2	+2	+2
c. Sleeping positional changes	-1	+1	+2	+1	+1	-1	-2	-2
d. Self grooming	-2	-2	-2	-2	-2	+1	+2	+2
e. Tail wagging	-2	-2	-1	+1	+1	+2	+2	+2
f. Standing and walking	-2	-2	-1	+1	+2	+2	+2	+2
4. Clinical well being	-2	-2	-2	-1	-1	+1	+2	+2

Table 19. Observations on mean sedation score and mean pain score during postoperative period in Group II animals (n=6)

Items	0 hr	1 hr	3hr	6hr	12 hr	24 hr	2 d	3d
Sedation score	3.3	2.0	1.0	-	-	-	-	-
Pain sore	7.3	5.3	3.7	2.7	1.3	0.5	-	-

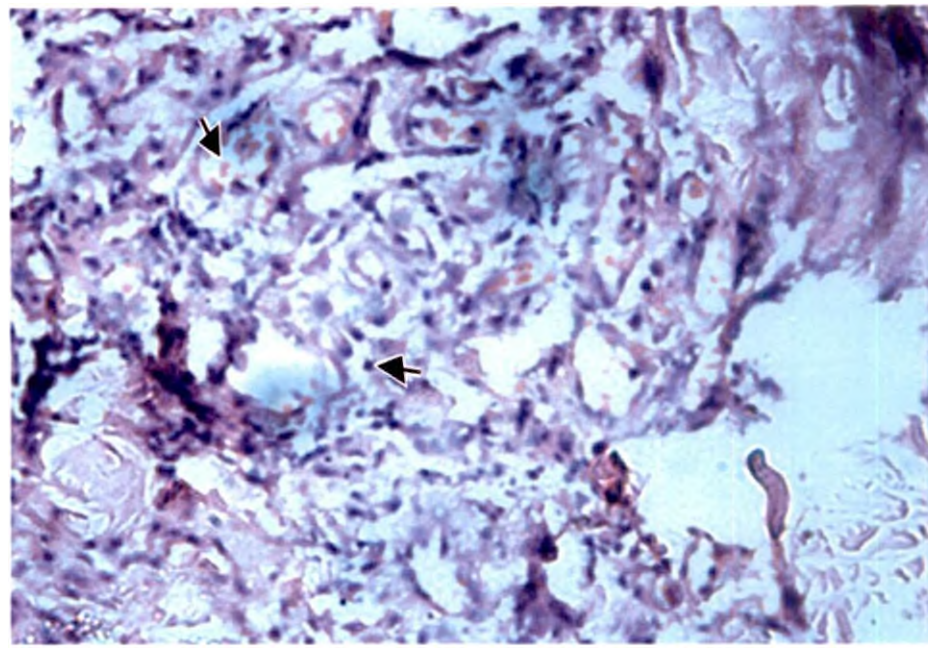

Fig. 11. Photomicrograph of surgical wound on 4th day showing infiltration of mononuclear cells along with capillary proliferation (H & E x 400)

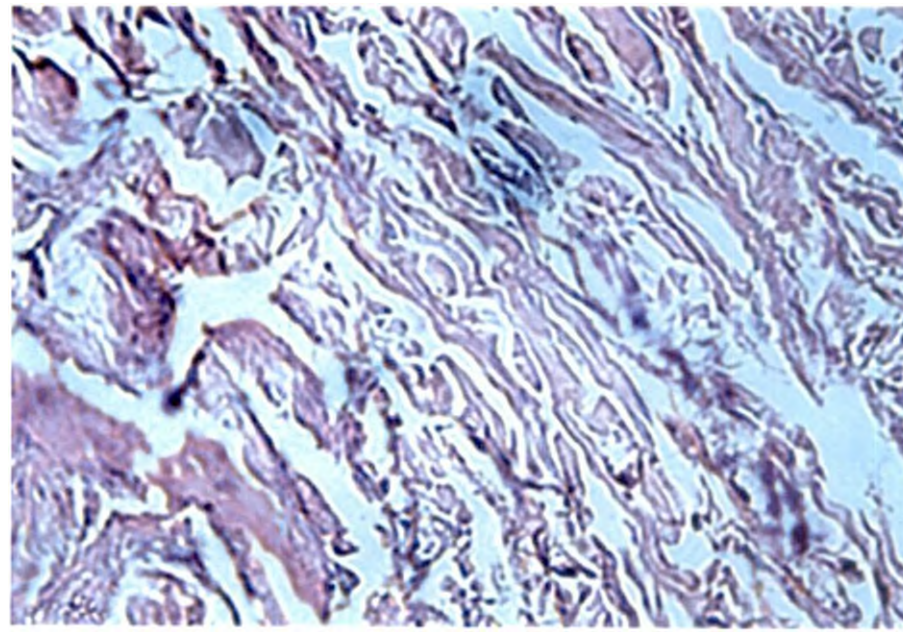

Fig. 12. Photomicrograph of surgical wound on 8th day showing proliferated collagen bundles and fibroplasia (H & E x 400)

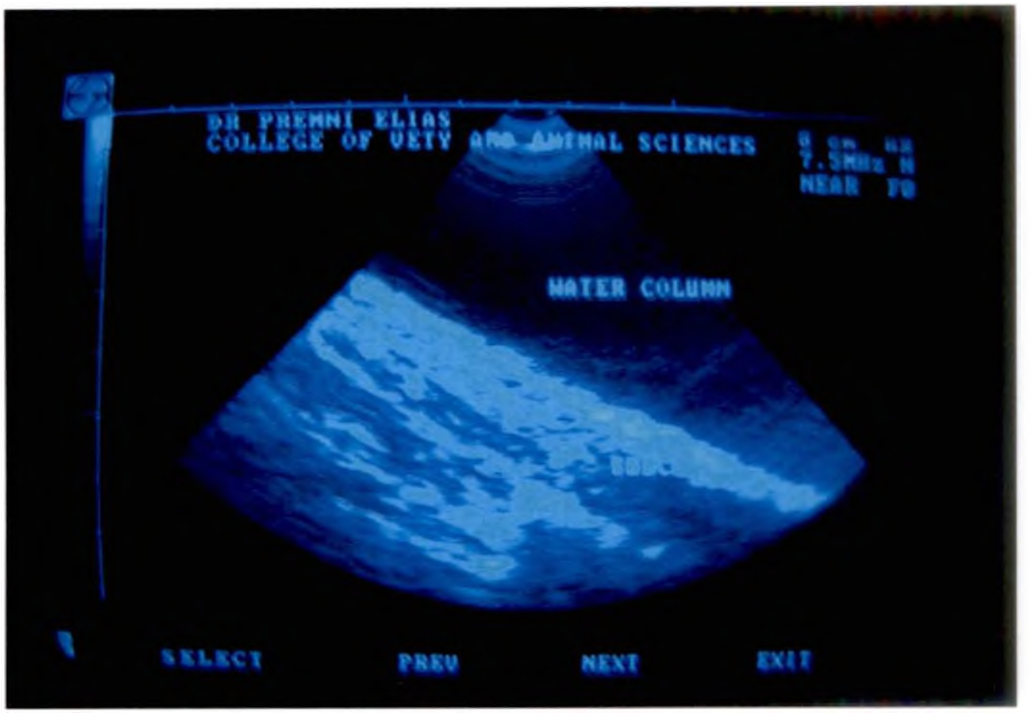

Fig.13. Representative ultrasonogram of the surgical wound site on 4th day in group II showing distance between epidermis and acoustic interface of subcutis (1.20 cm).

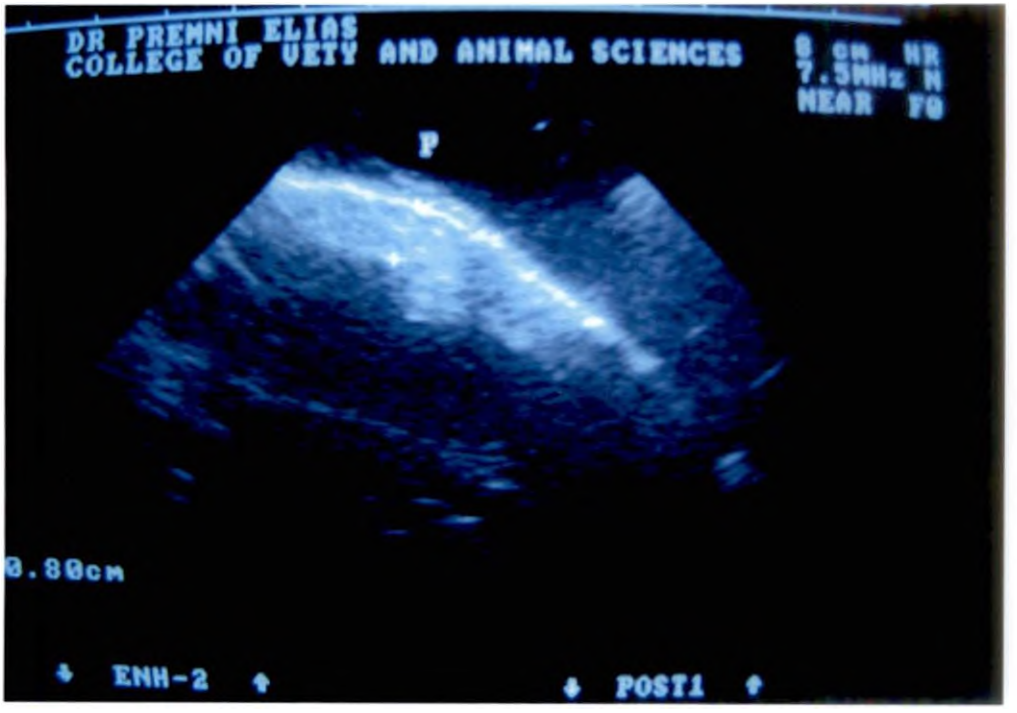

Fig.14. Representative ultrasonogram of the surgical wound site on 8th day in group II showing distance between epidermis and acoustic interface of subcutis (0.80 cm).

Discussion

5. DISCUSSION

Elective surgeries are usually performed in an overnight fasted state. This overnight fasted state represents additional metabolic stress that will be superimposed on the stress of anaesthesia and surgery. These metabolic responses will have deleterious effect on wound healing and postoperative recovery. Preoperative parenteral administration of dextrose has reported to be superior to fasted state in reducing endocrine responses to surgery. The study was conducted to evaluate the effect of preoperative dextrose infusion in alleviating stress, to promote healing and postoperative recovery.

Several steps were taken to minimize variation associated with differences among subjects. Female dogs that were comparable in age, weight, and stage of reproductive cycle were selected for the study. Dogs were admitted one week prior to the scheduled day of surgery to the kennel and the procedure was performed on the morning hours to limit as well as to standardize, stress associated with hospitalization and to minimise the variations in behaviour.

5.1 PREOPERATIVE CONSIDERATION

5.1.1 Preoperative Fasting

In adult animals, food intake is generally restricted 6 to 12 hours before induction of anaesthesia to avoid intraoperative or postoperative emesis and aspiration pneumonia (Fossum, 2002). In group I animals fasting time was 13.90 ± 0.57 hours (Table.4) and in group II animals it was 13.16 ± 0.47 hours (Table.12). The fasting time allowed in this study was similar to the duration usually followed in planned surgery.

5.1.2 Preoperative Stress

Almost all the animals hospitalized for elective surgery exhibited preoperative stress behaviours (Hennessy *et al.,* 1997; Houpt, 1998; Väisänen *et al.* 2005).

5.2 ANAESTHESIA

The combination of intravenous xylazine and ketamine produces a good general anaesthesia and has several advantages, such as an easy administration, rapid onset or termination of anaesthesia and few apparent clinical complications (Benson, *et al.*, 1985)

In Group I animals, duration for the time of induction, anaesthesia and recovery from anaesthesia were 2.08 ± 0.20, 49.16 ± 1.52 and 85.0 ± 3.41 min. respectively (Table.4) and in Group II animals, duration for the time of induction, anaesthesia and recovery from anaesthesia were 2.16 ± 0.16, 40.0 ± 1.29 and 45.83 ± 1.29 min. respectively (Table.12)

The mean induction time, mean arousal time, and mean walking time reported by Kim *et al.* (2004) in intravenous xylazine- ketamine is close with duration and recovery time in this study. Demirkan *et al.* (2002) reported an average of 54 minutes of anaesthesia by intravenous xylazine- ketamine which is similar to the duration of anaesthesia in group I and II animals. The duration of recovery was reduced to half in group II compared to group I animals. This reduction in recovery time is a favourable factor in animals and might be due to alleviation of perioperative stress following infusion of dextrose in fasting period.

5.3 SURGICAL PROCEDURE

Panhysterectomy was selected as the elective surgery and performed through midline laparotomy. All the surgeries were scheduled and conducted in morning hours. The surgical procedures in all the animals were performed by the same

surgical team to minimize variation within and between the groups. Duration of surgery in Group I was 41.66 ± 2.10 (Table.4) and in Group II was 41.66 ± 1.66 min. (Table.12). There was no difference between groups for duration of surgery.

5.4 MAIN ITEMS OF OBSERVATION

5.4.1 Physiological Parameters

5.4.1.1 Rectal Temperature

There was significant ($P<0.05$) decrease in rectal temperature immediately after surgery compared to preoperative value in group I and II. But variation in rectal temperature was not significant between groups throughout the period of observation (Fig.15). Decrease in rectal temperature immediately after surgery in the present study is in agreement with observations of Kim *et al.* (2004) and Demirkan *et al.* (2002) in dogs.

5.4.1.2 Pulse Rate

There was reduction in pulse rate immediately after surgery compared to preoperative value and it returned to normal value and remained in the normal range throughout the period of observation in group I and II animals (Fig.16). The reduction in pulse rate immediately after surgery was significant in group II. Demirkan *et al.* (2002) also observed similar finding during anaesthesia with xylazine -ketamine combination administered intravenous. No significant changes in pulse rate could be observed between groups throughout the observation period.

5.4.1.3 Respiration Rate

There was significant ($P<0.05$) decrease in respiration rate in group I and II animals immediately after surgery compared to presurgical value, but no significant difference could be noted between group I and II animals during the observation period (Fig.17). Significant decrease in respiration rate immediately after surgery is

in agreement with the findings of Kim *et al.* (2004) and Demirkan *et al.* (2002) in dogs.

5.4.2 Haematological Parameters

5.4.2.1 Neutrophil Count

There was significant ($P<0.05$) increase in the mean neutrophil count at 24th hour and on 4th day postoperatively compared to preoperative value in group I and II animals, but no significant variation was observed between groups throughout the period of observation (Fig.18). Similar findings were noted by Schmidt and Booker (1982), and Lemke *et al.* (2002a) after ovariohysterectomy in dogs.

5.4.2.2.Lymphocyte Count

There was significant ($P<0.05$) decrease in the mean lymphocyte count at 24th hour and on 4th day compared to preoperative value in group I and II animals, but no significant changes between groups were noted throughout the observation period (Fig.19). The present finding is close with Schmidt and Booker (1982) and Lemke *et al.* (2002a) after ovariohysterectomy in dogs.

Eosinophil and monocyte count revealed marginal variation throughout the period of observation.

5.4.2.3 White Blood Cell count

The mean white blood cell count significantly ($P<0.05$) decreased immediately after surgery, then increased significantly at 24th hour postoperatively compared to preoperative value in group I and II animals, but no significant changes in the mean white blood cell count could be observed between group I and group II animals throughout the period of observation (Fig.20). The present finding is in agreement with Schmidt and Booker (1982) and Lemke *et al.* (2002a) in dogs after ovariohysterectomy.

5.4.2.4 Haemoglobin

There was significant ($P<0.05$) reduction in haemoglobin concentration immediately after surgery and there after the level improved to normal physiological range throughout the period of observation in both the groups, but the variations were not significant between group I and II animals (Fig.21). The present findings do agree with Lemke *et al.* (2002a) in dogs. The transient reduction in haemoglobin might be the effect of anaesthesia and surgery.

5.4.2.5 Volume of Packed Red Cells

The mean volume of packed red cells in group I and II animals decreased immediately after surgery compared to preoperative value, but was significant ($P<0.05$) only in group II animals. Significant changes in the mean volume of packed red cells could not be observed between group I and II animals during the observation period and remained in the normal physiological level (Fig.22). The present finding is close with Gaynor *et al.* (1996) who observed that administration of dextrose containing solution caused no significant changes in packed cell volume and Lemke *et al.*, (2002a) after ovariohysterectomy in dogs.

The changes observed in the haemogram might be due to the transient period of cellular reaction to trauma elicited towards the healing process (Pascoe, 1985) especially when there were no signs of sepsis at surgical site.

5.4.3 Biochemical Parameters

5.4.3.1 Cortisol

In group I and II animals, there was significant ($P<0.05$) increase in the cortisol concentration immediately after surgery and returned to basal level by 24th hour postoperatively (Fig.23). The present finding is in agreement with Schmidt and Booker (1982) in dogs after ovariohysterectomy and Beerda *et al.* (1996) in dogs

after stress induced response. Hansen *et al.* (1997), Kyles *et al.* (1998), and Benson *et al.* (2000) made similar observations in dogs after ovariohysterectomy.

In group II animals, significant ($P<0.05$) decrease in elevation of cortisol concentration in the immediate postoperative period was observed compared to group I animals. The lowered increase in the cortisol concentration in group II compared to group I might due to alleviation of stress from preoperative fasting, anaesthesia and surgery consequent to preoperative infusion of dextrose. Nygren *et al.* (1998) made similar observations in human patients received preoperative glucose infusion.

5.4.3.2 Glucose

In group I and group II animals, there was significant ($P<0.05$) increase in the glucose concentrations immediately after surgery and became near normal level by 4^{th} day and 8^{th} day postoperatively compared to preoperative value (Fig.24). The present finding is in agreement with Smith *et al.*, (1999) in cats underwent ovariohysterectomy and Somboonviboon and Kijmahatrakul (1996) in human paediatric patients after surgery and anaesthesia.

In group I animals, glucose concentration remained in the lower level at 24^{th} hour postoperatively and it might be due to reduction in feeding on the day of surgery. The observations of Lemke *et al.* (2002 b) in dogs after surgery do agree with reduction in glucose level at 24^{th} hour postoperatively in group I animals.

Group II animals showed significant ($P<0.05$) decrease in elevation of glucose concentration in the immediate postoperative period compared to group I animals. Preoperative dextrose infusion might have maintained insulin sensitivity in group II and it is in agreement with the present finding (Soop *et al.*, 2001).

5.4.3.4 Total protein, albumin and globulin

There was significant ($P<0.05$) decrease in the total protein content immediately after surgery in group I and II animals, but significant changes was not observed between groups in total protein, albumin and globulin content throughout the observation period (Fig.25 to 27). These findings are in agreement with Lemke *et al.* (2002 a) and Gaynor *et al.* (1996) in dogs underwent elective ovariohysterectomy.

5.4.3.5 Blood Urea Nitrogen

There was a significant ($P<0.05$) increase in the blood urea nitrogen level immediately after surgery and 24th hour in group I and II and returned to preoperative value by 4th postoperative day. The variations in blood urea nitrogen level were not significant throughout the observation period and were within the normal physiological limit (Fig.28). Schmidt and Booker (1982) also made similar findings in dogs after ovariohysterectomy.

5.4.3.6 Sodium and Potassium

There was decrease in sodium concentration and an increase in potassium concentration immediately after surgery and there after variations were marginal and within the normal physiological limit. Significant changes could not be noted throughout the observation period between group I and II animals (Fig.29 and 30).

5.5 EVALUATION OF WOUND HEALING

Moderate swelling, erythema, serosanguinous discharge from the surgical site was noted in first 24 hours in both the groups and it get reduced by 4th day, and normal wound healing was noted on 8th day. Apparent difference could not be noted in healing throughout the period of observation in either group (Table.9 and 17) and the complications did not occur except for one in group I.

The histologic appearance of surgical wound between groups on 4th and 8th day was similar. The general healing pattern of all the wound was similar with regard

to cellular and fibrous components (Fig.7, 8, 11 and 12). Although rate of healing differed at different time, the general progression of healing was similar between groups. A progressive increase in the fibroblast and collagen were observed on 8th day postoperatively in both the groups. Swaim *et al.* (1996) reported acute inflammation in the pad wound of dogs characterized by large number of neutrophils and macrophages up to 14 days. By 6th day fibroblast, blood vessels and the amount of collagen in the wound bed were greater than that observed at day three do agree with the present finding. Varma *et al.* (1981) studied tissue reaction to suture materials in infected surgical wounds and observed nylon elicited slightly more reaction. The predominant cells by 6 days were neutrophils. On 10th day macrophages and fibroblast supports histologic findings in the present study.

In the present study the distance between epidermis and the acoustic interface of sub cutis was increased to 1.20 cm in both the groups on 4th day and later it reduced to 0.80 cm. The variation in the distance between epidermis and subcutis might be due to inflammatory oedema at a surgical site (Fig.9, 10, 13 and 14). Clinical assessment of wound score and histologic findings also support the ultrasonogaphic pattern of wound healing.

5.6 ASSESSMENT OF PATIENT DURING POSTOPERATIVE RECOVERY PERIOD

5.6.1 Activity and Alertness

Normal activity and alertness were attained on 3rd postoperative day in group I. This finding is in agreement with Vaisanen *et al.* (2004) in dogs after different soft tissue surgeries. In group II animals, alertness and activity clearly increased from 24th hour postoperatively and reached to normal playfulness by 2nd day postoperatively (Fig. 31).

5.6.2 Feeding Habits

Animals in group I started feeding by 2nd day postoperatively, reached the normal appetite and feeding habits by 4th day. This is in agreement with Vaisanen *et al.* (2004) in dogs after different soft tissue surgeries. In group II, animals started feeding of liquid and a little amount of solid food on the day of surgery itself (Fig. 32). Similar observation was noted by Nygren *et al.* (1998) in human beings.

5.6.3 Behavioural Changes

In group I, animals maintained lateral recumbency up to 12 hours and strenal recumbancy from 12 to 24 hours, sleeping positional changes were increased up to 24th hour, self grooming was clearly increased by 3rd day postoperatively. Greeting behaviour like tail wagging increased to some extent by 24th hour and started standing and walking with minimum disorientation on 24th hour (Fig.33 to 38). The present finding is in agreement with Fox *et al.*, (1998), Hardie *et al,* (1997) and Kyles *et al.* (1998) in dogs underwent ovariohysterectomy. Group II animals maintained sternal recumbancy from 6th hour, sleeping positional changes were reduced by 6 to 12 hours, self grooming clearly increased on 2nd day, tail wagging clearly increased from 24th hour and started standing and walking by 6th postoperative hour onwards. A faster return to normal behaviour after surgery was noted in group II. Similar observations were reported by Soop *et al.* (2001) in human beings.

5.6.4 Clinical well being

Faster recovery and early return to normal activity in group II suggest that animals attained clinical well being by 2nd postoperative day compared to group I animals on 4th day.

5.6.5 Sedation Score

Animals in group I showed greater mean sedation scores up to 6th postoperative hour and reduced by 24th hour postoperatively. These findings are in agreement with observations of Kyles *et al.* (1998), Lascelles *et al.* (1997) and Hardie *et al.* (1997). But animals in group II, sedation scores were reduced by 3rd postoperative hour and were able to walk with minimum ataxia from 6th hour onwards (Fig.39).

5.6.6 Pain Score

The pain scores were greater by 12th hour from immediately after surgery and reduced at 24th hour postoperatively in group I animals. Hardie *et al.* (1997), Kyles *et al.* (1998) and Lemke *et al.* (2002) made similar observation in dogs underwent ovariohysterectomy. In group II animals showed minimum pain behaviour by 6th hour postoperatively and were relatively painless on 2nd and 3rd day (Fig.40).

The observations on activity, alertness, feeding habits, behavioural changes, sedation score and pain score indicated more promising changes in the postoperative period in group II compared to group I. These changes are definitely improving patient well being and early return to normal habits after major surgery.

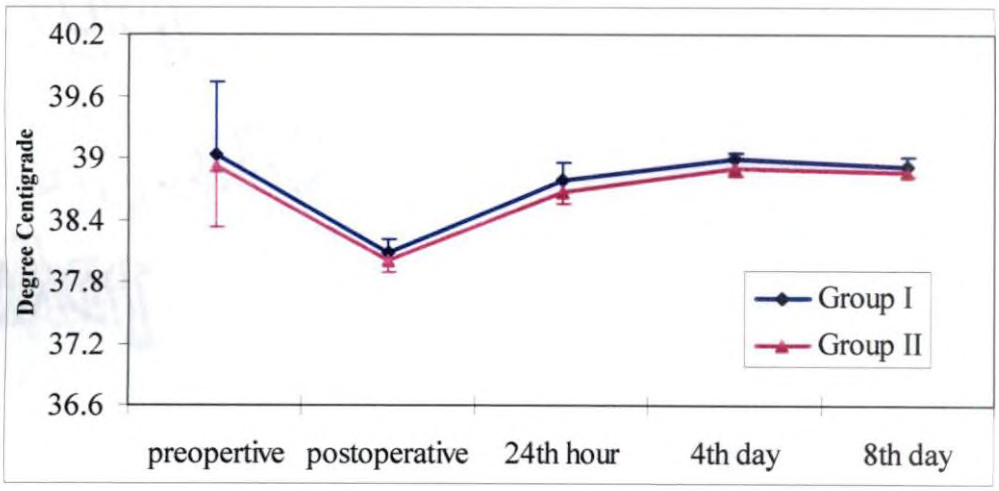

Fig.15. Comparison of rectal temperature during observation period in Group I and II

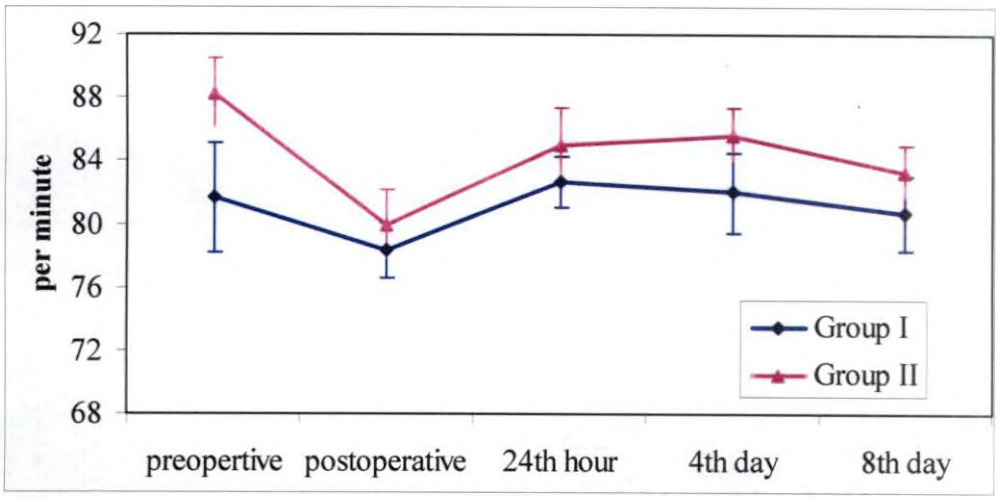

Fig.16. Comparison of pulse rate during observation period in Group I and II

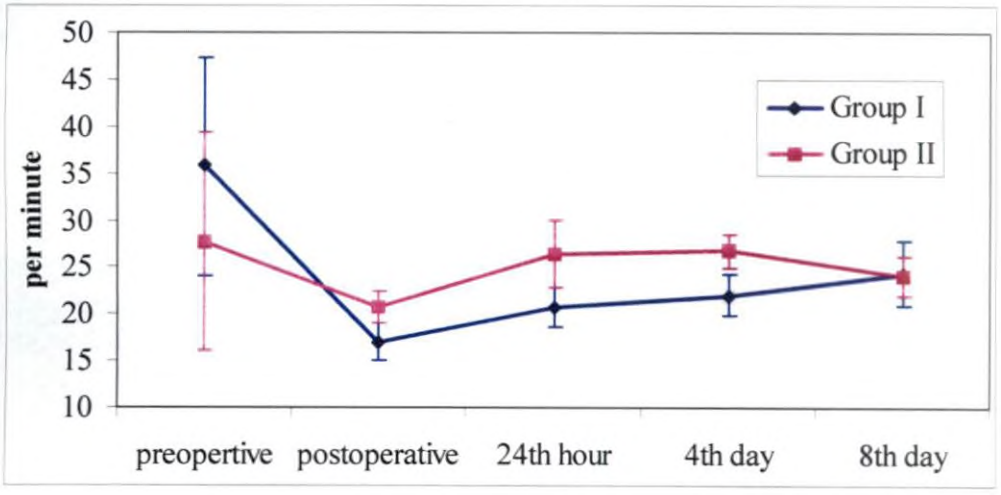

Fig.17. Comparison of respiration rate during observation period in Group I and II

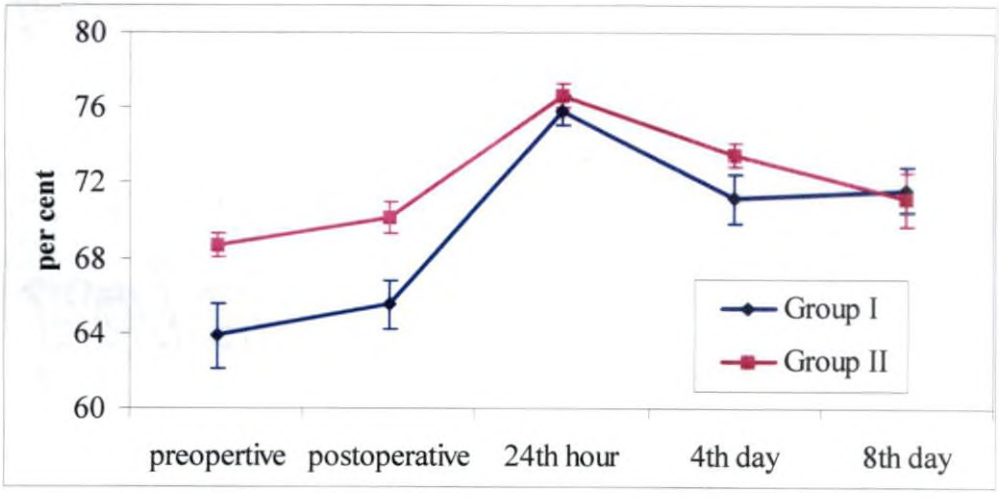

Fig.18. Comparison of neutrophil count during observation period in Group I and II

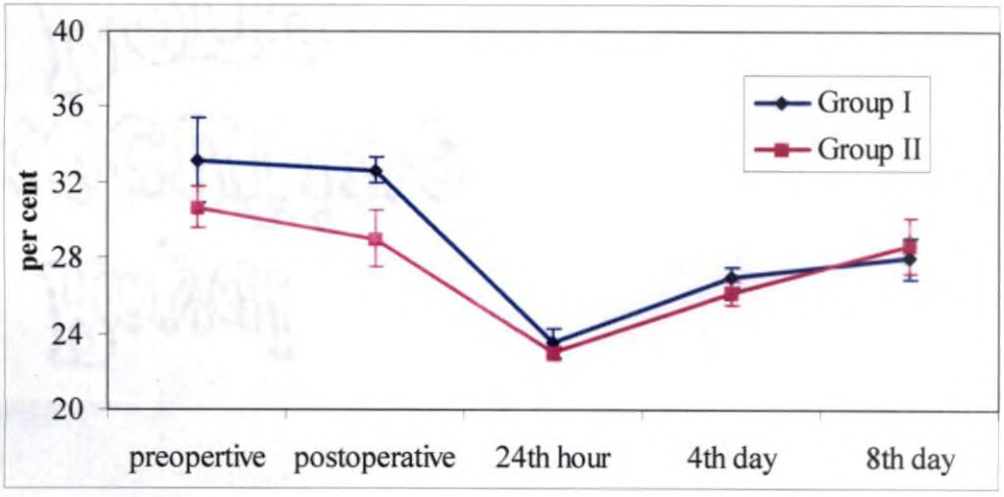

Fig.19. Comparison of lymphocyte count during observation period in Group I and II

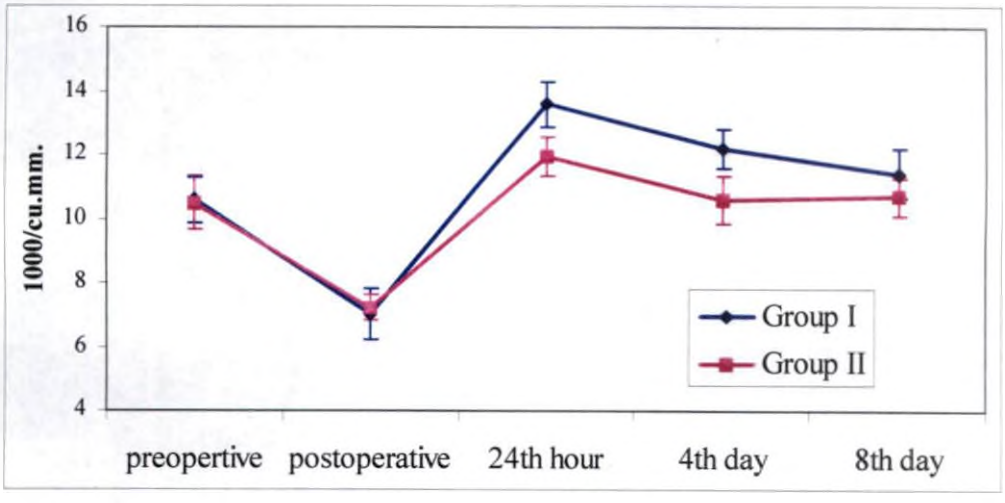

Fig.20. Comparison of white blood cell count during observation period in Group I and II

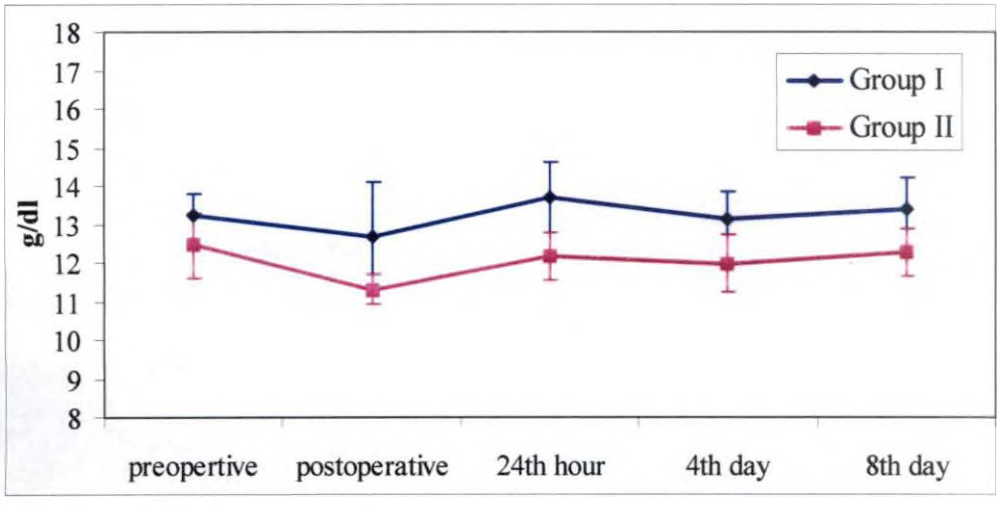

Fig.21. Comparison of haemoglobin concentration during observation period in Group I and II

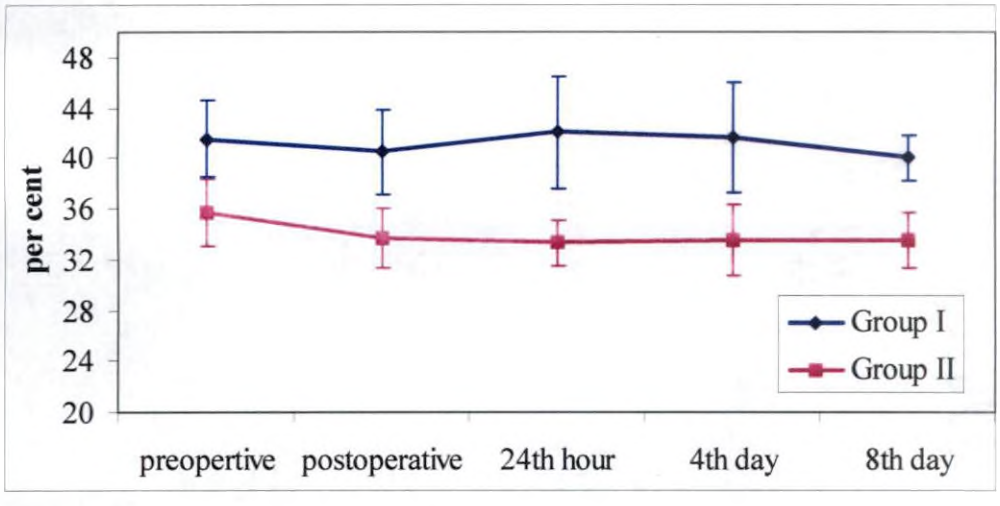

Fig.22. Comparison of volume of packed red cells during observation period in Group I and II

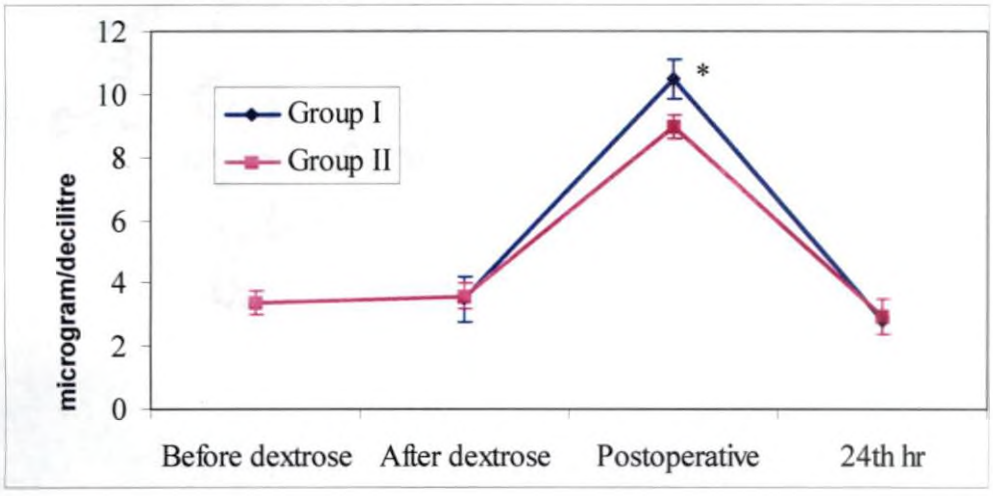

Fig.23. Comparison of cortisol concentration during observation period in Group I and II

* Significant variation between groups immediately after surgery

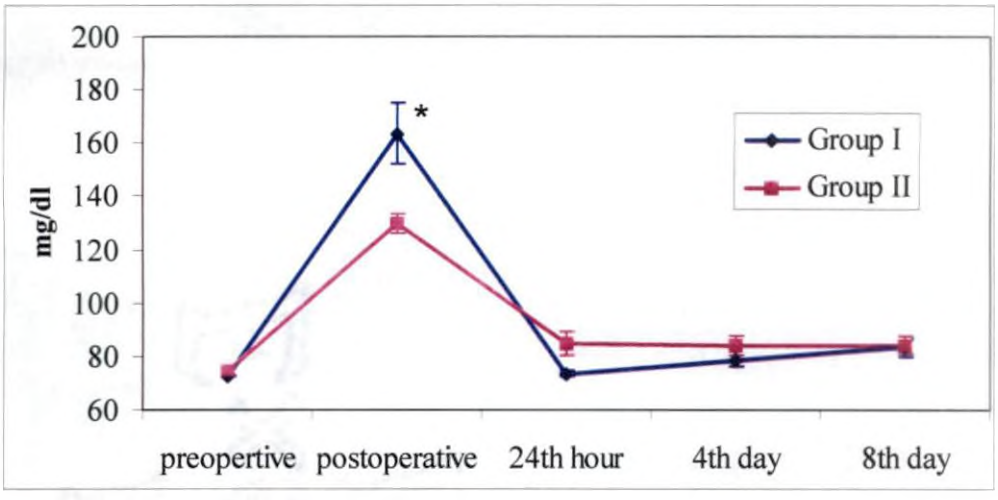

Fig.24. Comparison of glucose concentration during observation period in Group I and II

* Significant variation between groups immediately after surgery

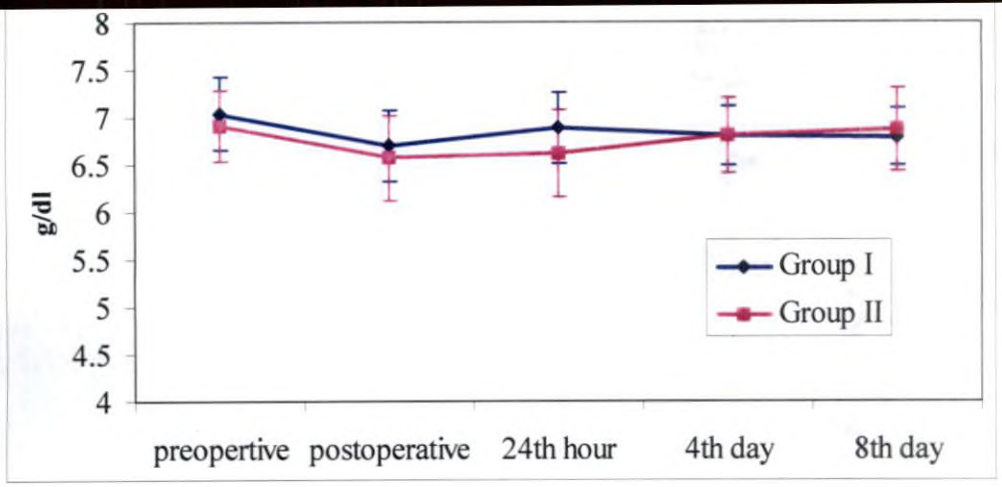

Fig.25. Comparison of total protein content during observation period in Group I and II

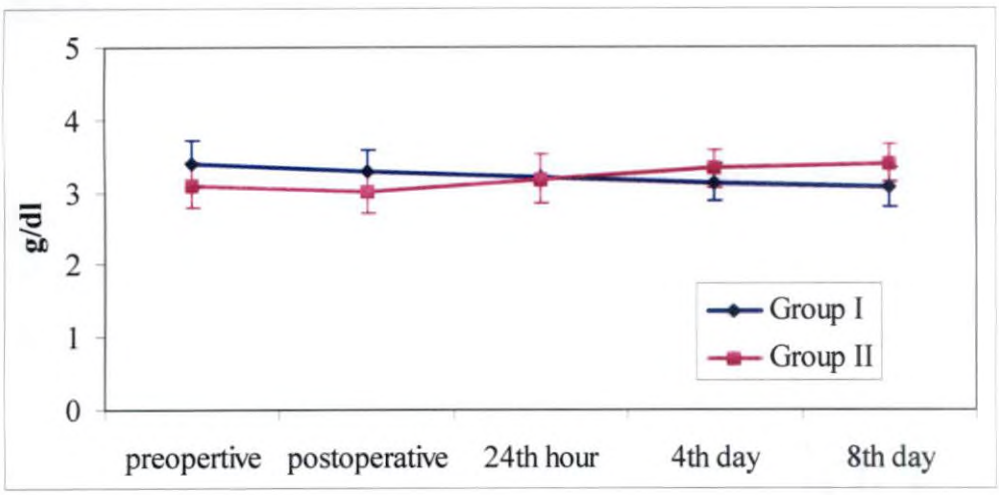

Fig.26. Comparison of albumin content during observation period in Group I and II

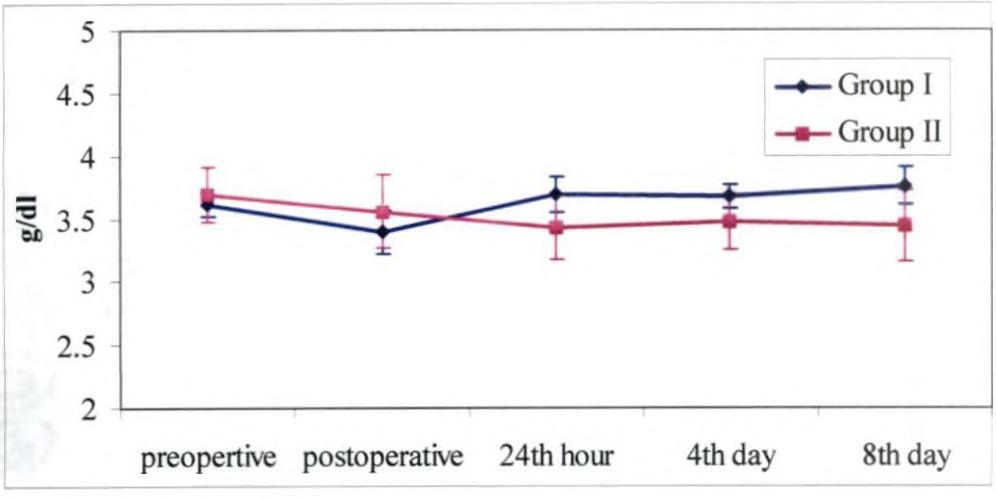

Fig.27. Comparison of globulin content during observation period in Group I and II

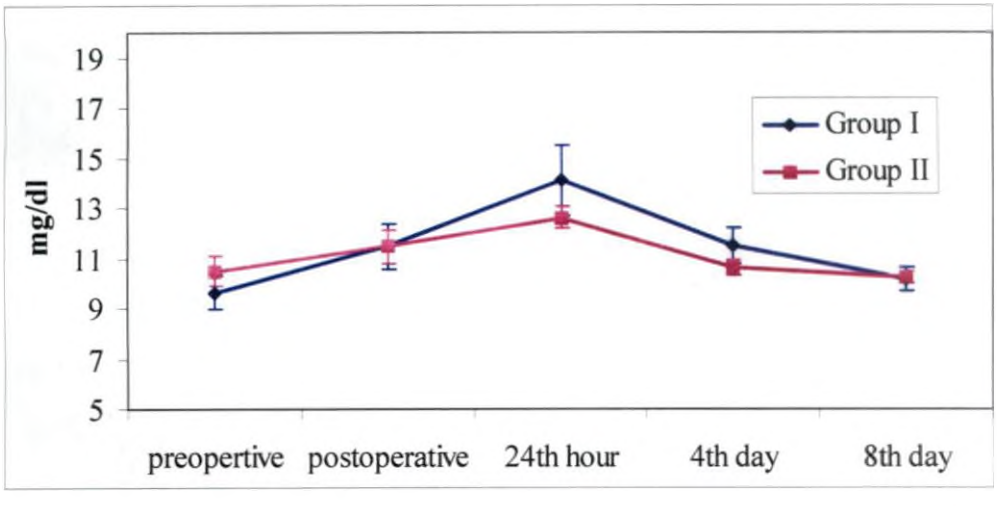

Fig.28. Comparison of blood urea nitrogen level during observation period in Group I and II

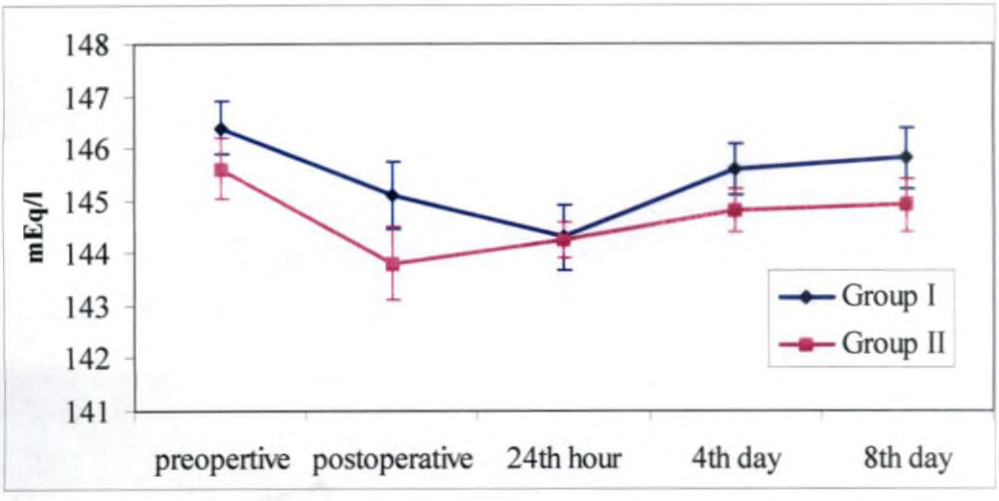

Fig.29. Comparison of sodium concentration during observation period in Group I and II

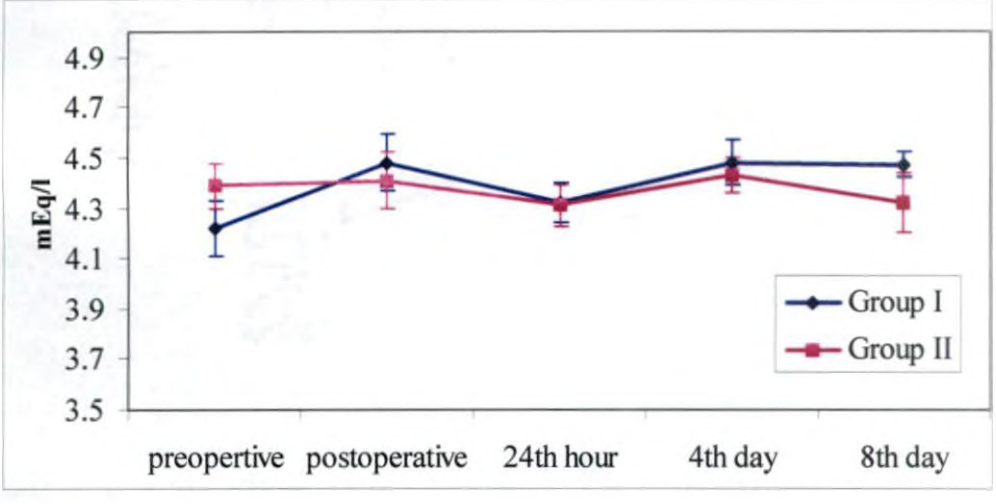

Fig.30. Comparison of potassium concentration during observation period in Group I and II

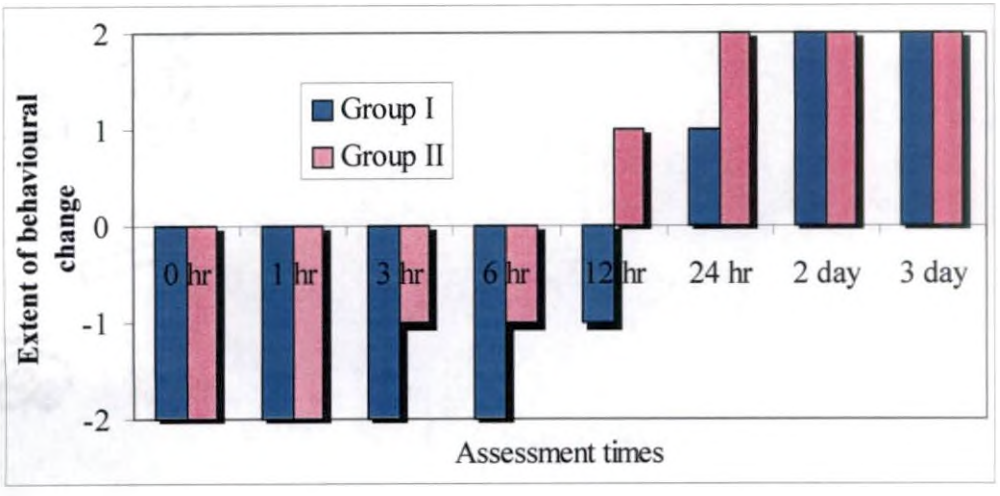

Fig. 31. Comparison of assessment of activity and alertness in group I and II animals during postoperative period

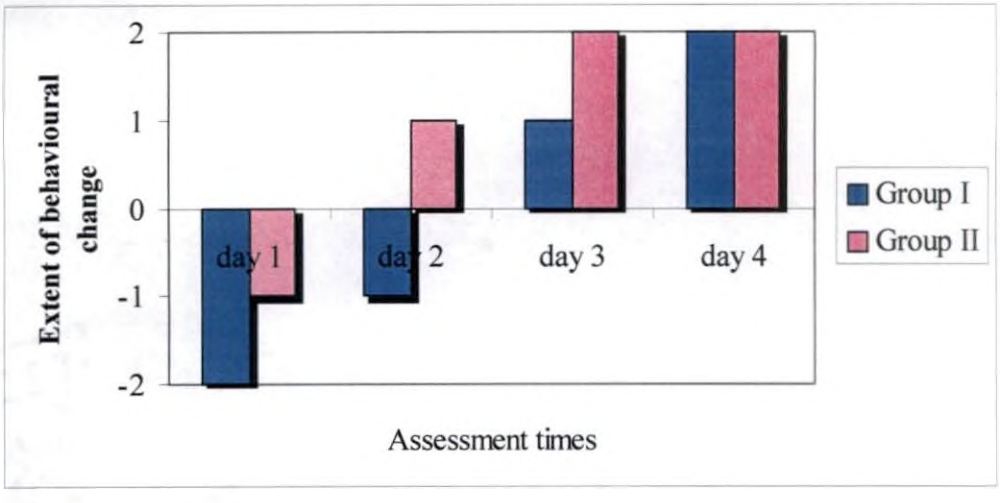

Fig. 32. Comparison of assessment of feeding habits in group I and II animals during postoperative period

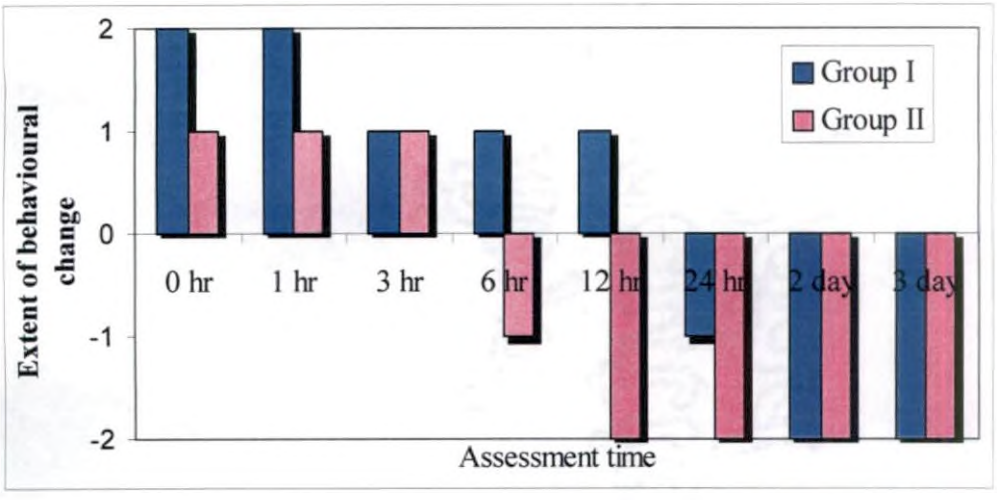

Fig. 33. Comparison of assessment of lateral recumbency in group I and II animals during postoperative period

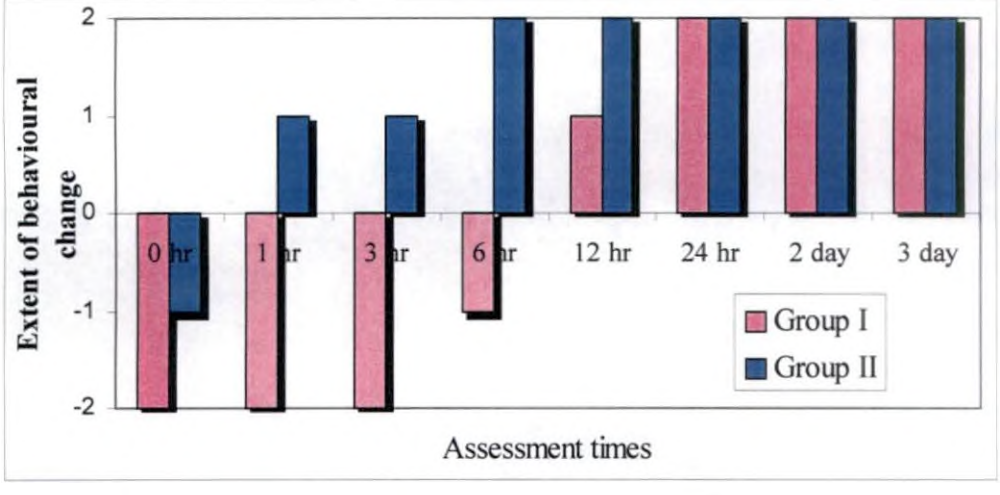

Fig. 34. Comparison of assessment of sternal recumbency in group I and II animals during postoperative period

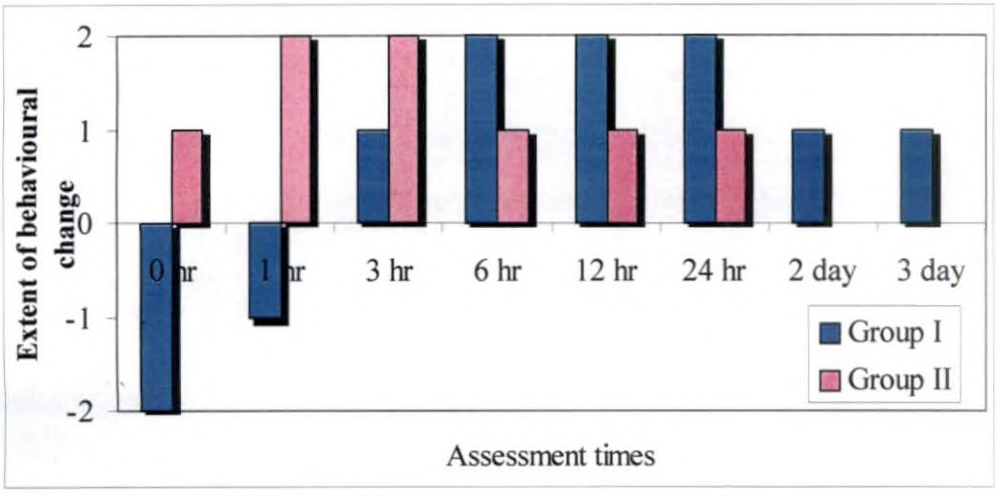

Fig. 35. Comparison of assessment of sleeping positional changes in group I and II animals during postoperative period

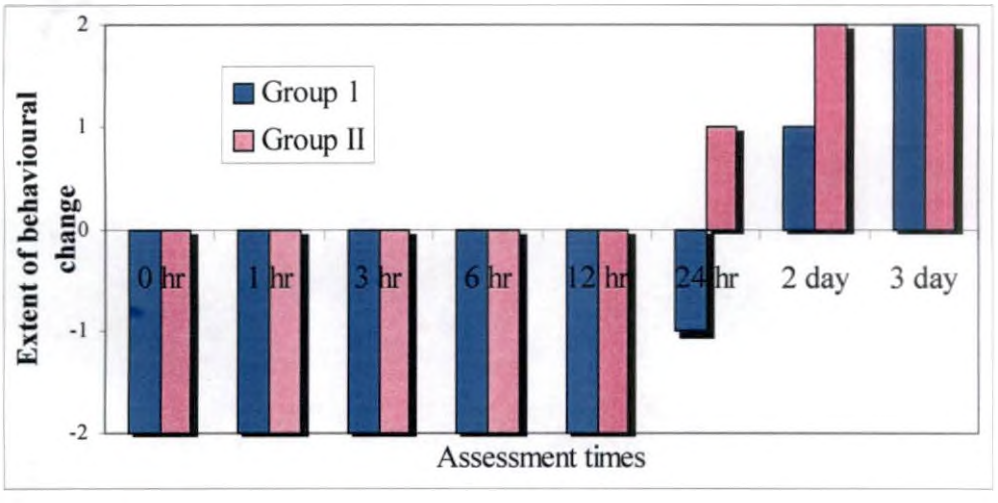

Fig. 36. Comparison of assessment of self grooming in group I and II animals during postoperative period

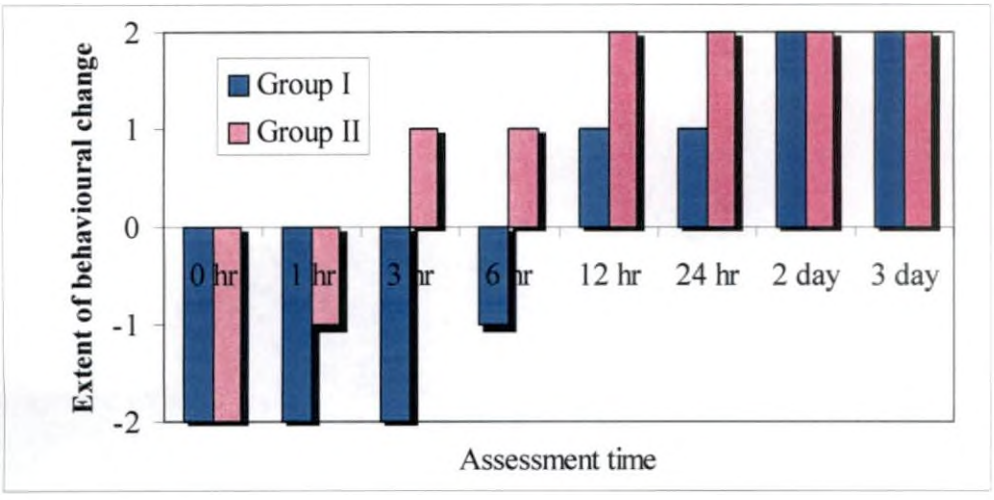

Fig. 37. Comparison of assessment of standing and walking in group I and II animals during postoperative period

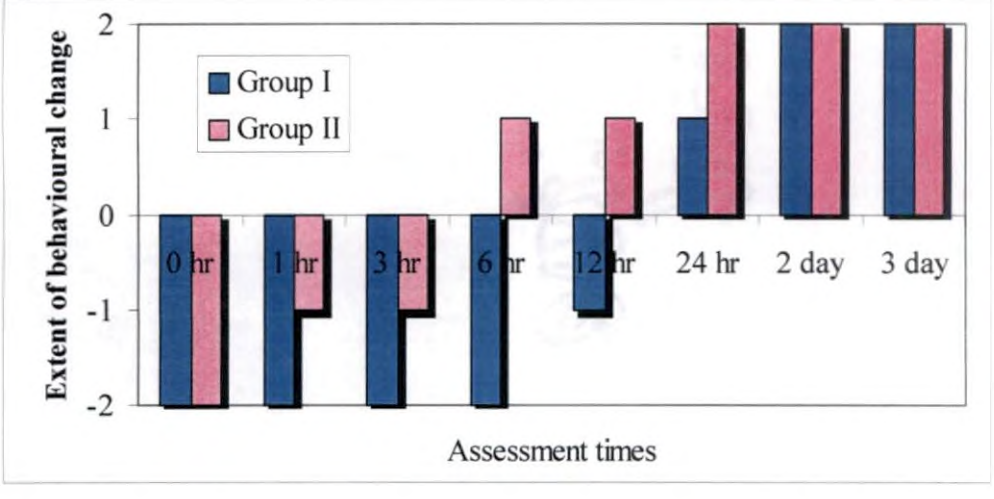

Fig. 38. Comparison of assessment of tail wagging in group I and II animals during postoperative period

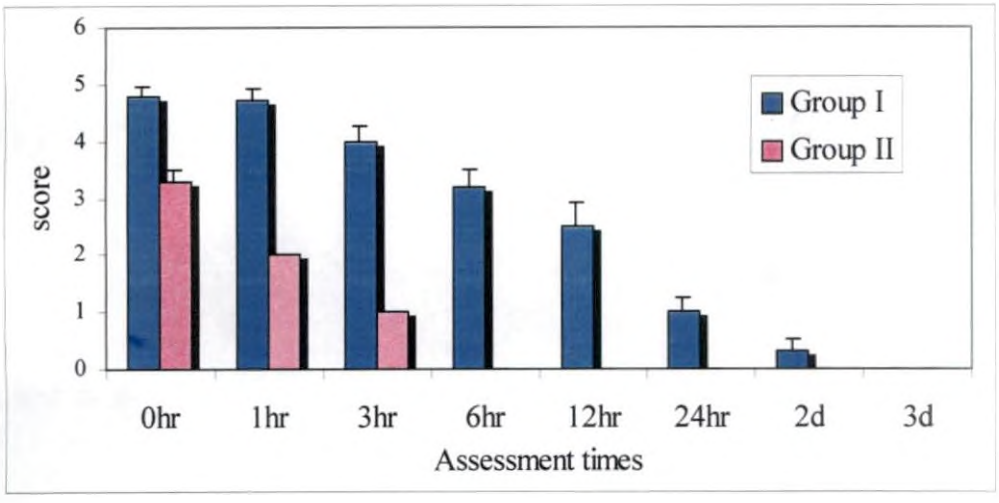

Fig. 39. Comparison of sedation score in group I and II animals during postoperative period

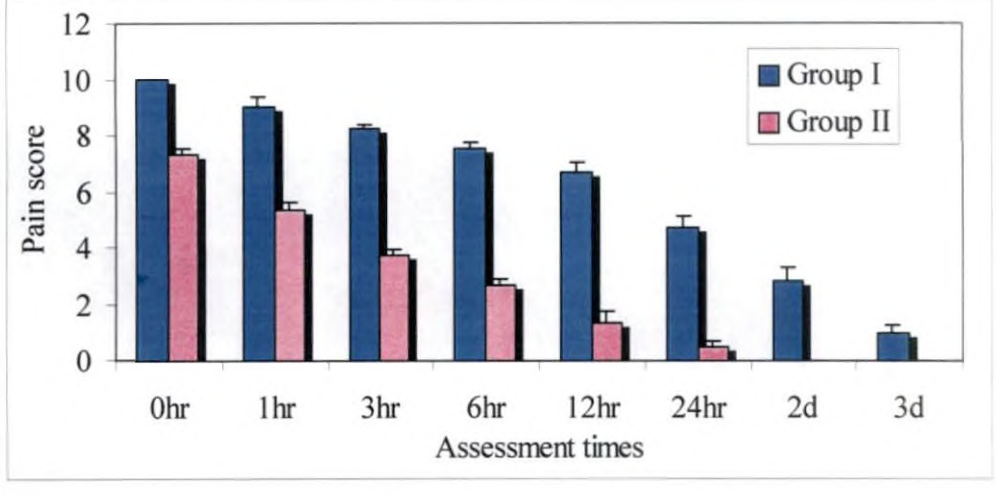

Fig. 40. Comparison of pain score in group I and II animals during postoperative period

Summary

6. SUMMARY

The study was carried out in twelve clinically healthy nondescript bitches presented to the clinics of College of Veterinary and Animal Sciences, Mannuthy for panhysterectomy. The animals were divided into two groups consisting of six each. In group I, panhysterectomy was done under general anaesthesia after overnight fasting and in group II, panhysterectomy was done under general anaesthesia after overnight fasting and administration of 12.5 per cent dextrose at the rate of 5 ml per kg intravenously two hours prior to induction of anaesthesia.

Animals were observed for the behavioural signs of preoperative stress and found that all animals hospitalized for elective surgery exhibited preoperative stress behaviours due to separation anxiety and exposure to novel surroundings.

The animals were anaesthetised after premedication with atropine sulphate (0.045 mg/kg bodyweight) and xylazine (1.5 mg/kg bodyweight) intramuscularly. Ten minutes later xylazine (20 mg/ml) and ketamine (50 mg/ml) combination was administered intravenously to effect anaesthesia for the surgical procedure.

Time for induction of anaesthesia, duration of anaesthesia and recovery from anaesthesia were 2.08 ± 0.28, 49.16 ± 1.52 and 85.0 ± 3.41 min. respectively in group I, and 2.16 ± 0.16, 40.0 ± 1.29 and 45.83 ± 1.29 min. respectively in group II. The duration of recovery was reduced to half in group II compared to group I.

There was significant ($P<0.05$) decrease in rectal temperature immediately after surgery compared to preoperative value in group I and group II, but no significant variation in rectal temperature could be observed between groups throughout the period of observation.

Pulse rate in group I and II decreased immediately after surgery and remained in the normal range from 24th hour postoperatively. The reduction in pulse rate was

significant (P<0.05) in group II. No significant changes in pulse rate could be observed between groups throughout the period of observation.

Respiration rate in group I and group II showed significant (P<0.05) decrease immediately after surgery compared to preoperative value, but no significant difference could be noted between group I and II throughout the observation period.

Colour of mucous membrane and capillary refill time revealed no significant changes during the period of observation.

The mean neutrophil count significantly (P<0.05) increased among groups at 24^{th} hour and on 4^{th} day postoperatively compared to preoperative value, but no significant variation in mean neutrophil count between groups could be observed throughout the period of observation.

The mean lymphocyte count decreased significantly (P<0.05) at 24^{th} hour and on 4^{th} day postoperatively compared to preoperative value in group I and II, but no significant variation in mean lymphocyte count could be observed between groups throughout the observation period.

Eosinophil and monocyte count revealed marginal variation throughout the period of observation.

The mean white blood cell count significantly (P<0.05) decreased immediately after surgery and then increased significantly at 24^{th} hour postoperatively compared to preoperative value in group I and II, but no significant changes could be observed between groups throughout the period of observation

The mean haemoglobin concentration was significantly (P<0.05) reduced immediately after surgery among groups and there after the level improved to normal physiological range throughout the period of observation. No significant changes in mean haemoglobin concentration could be observed between groups throughout the observation period.

The mean volume of packed red cells in group I and II decreased immediately after surgery compared to preoperative value, but it was significant ($P<0.05$) only in group II. No significant changes in the volume of packed red cells could be observed between groups during the observation period.

The cortisol concentration increased significantly ($P<0.05$) in group I and II immediately after surgery and returned to basal level 24^{th} hour postoperatively. In group II, significant ($P<0.05$) decrease in elevation of cortisol concentration in the immediate postoperative period was noted compared to group I.

The glucose concentration was significantly ($P<0.05$) increased immediately after surgery compared to preoperative value in group I and group II and became normal level by 4^{th} and 8^{th} day postoperatively. In group I, glucose concentration remained in the lower level at 24^{th} hour postoperatively. Group II showed significant ($P<0.05$) decrease in elevation of glucose concentration in the immediate postoperative period compared to group I.

The total protein content significantly ($P<0.05$) decreased immediately after surgery among group I and II, but significant changes were not observed in total protein, albumin and globulin content throughout the observation period.

The blood urea nitrogen level increased significantly ($P<0.05$) in the immediate postoperative period and 24^{th} hour postoperatively in group I and II and returned to preoperative value by 4^{th} postoperative day. The variations in the blood urea nitrogen level between groups were not significant throughout the observation period.

There was decrease in sodium concentration and increase in potassium concentration immediately after surgery, variations were marginal and within the normal physiological limits. No significant changes could be noted throughout the observation period between groups.

Apparent difference could not be noted in clinical assessment of wound healing score in either group. The rate of healing was different at different time, but the general healing pattern relating to cellular and fibrous components were similar between groups. The ultrasonography revealed increased distance between epidermis and subcutis on 4th day and it get reduced on 8th day, but no difference could be observed between groups.

In group I, animals attained normal activity and alertness on 3rd postoperative day, but in group II, activity and alertness increased from 24th hour and reached normal playfulness by 2nd day postoperatively.

Animals in group I started feeding by 2nd day and reached normal appetite and feeding habits by 4th postoperative day, but in group II, resumed normal feeding habits by 2nd day itself.

In group I, animals spend more time on sleeping in lateral recumbency during 12 hours and reached sternal recumbency by 12 to 24 hours and started walking with minimum disorientation by 24th hour postoperatively. Greeting behaviours and self grooming reduced in group I and reached normal by 2nd day postoperatively. But in group II, animals maintained sternal recumbency from 6th hour and started standing and walking with minimum disorientation by 6th postoperative hour. A faster return to normal greeting behaviour and self grooming was noted in group II.

Faster recovery and early return to normal activity in animals of group II compared to group I suggest that animals of group II attained clinical well being by 2nd postoperative day compared to group I on 4th day.

Animals in group I showed greater mean sedation scores up to 6th postoperative hour and it reduced by 24th hour postoperatively but animals in group II, sedation scores were reduced by 3rd postoperative hour and were able to walk from 6th hour onwards with minimum ataxia.

The pain scores were greater during 12 hours from immediately after surgery and reduced at 24th hour postoperatively in group I. In group II, animals showed minimum pain behaviour at 6th hour postoperatively and were relatively painless from 2nd day.

Based on the observations, the following conclusions could be drawn from the study:

1. Preoperative infusion of 12.5 per cent dextrose solution in the fasting period two hours prior to anaesthesia did not cause significant change in cortisol level. Hence it did not cause any additional stress in animals hospitalized for elective surgery.
2. A significant reduction in stress in the immediate postoperative period was noted as indicated by lowered elevation of cortisol and glucose level, and early anaesthetic recovery in animals received dextrose infusion in the preoperative period.
3. Faster recovery and early return to normal activity and feeding habits were observed in animals received dextrose infusion in the preoperative period.
4. Less sedation score and pain sores attributing to improved clinical well being during postoperative observation period were recorded in animals received preoperative dextrose infusion.
5. Wound healing pattern in gross appearance was not influenced by preoperative dextrose infusion, but changes at the ultrastructural levels require further studies.
6. The positive benefits in terms of improved postoperative outcome and patient well being after elective surgery recommends preoperative dextrose infusion in dogs as a general protocol in future practice in animal surgery.

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INFLUENCE OF PREOPERATIVE DEXTROSE INFUSION IN DOGS FOR ELECTIVE SURGERY

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Abstract of the thesis submitted in partial fulfilment of the requirement for the degree of

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ABSTRACT

The study was conducted in twelve clinically healthy nondescript bitches presented to the clinics of College of Veterinary and Animal Sciences, Mannuthy for panhysterectomy, to evaluate the effect of preoperative dextrose infusion in alleviating stress, to promote healing and postoperative recovery.

The animals were divided into two groups. In Group I, panhysterectomy was done under general anaesthesia after overnight fasting and in group II, panhysterectomy was done under general anaesthesia after overnight fasting and administration of 12.5 per cent dextrose at the rate of 5 ml per kg intravenously two hours prior to induction of anaesthesia.

Physiological, haematological and biochemical parameters were estimated before surgery, immediately after surgery, at 24^{th} hour, on 4^{th} day and 8^{th} day postoperatively. Cortisol concentration was estimated before surgery, immediately after surgery and at 24^{th} hour postoperatively in Group I, and before dextrose infusion, before surgery, immediately after surgery and at 24^{th} hour postoperatively in Group II. Wound healing and recovery were assessed during postoperative period.

The duration of recovery was reduced to half in group II compared to group I. Significant difference in physiological parameters like rectal temperature, pulse rate and respiration rate could be observed among groups during the observation periods, but was not significant ($P<0.05$) between groups. Generalised leucopenia detected immediately after surgery and became mild leucocytosis with concurrent neutrophilia and lymphopenia were noted among groups by 24^{th} hour postoperatively. The variation in haematological parameters was not significant between groups. There was significant ($P<0.05$) increase in the cortisol and glucose concentrations immediately after surgery compared to preoperative value in both the groups, but a significant ($P<0.05$) decrease in those animals received preoperative dextrose infusion compared to group I. The general healing pattern related to cellular

and fibrous components were similar between the groups. Faster recovery and early return to normal activity and feeding habits were observed in animals received dextrose infusion in the preoperative period.

In the present study preoperative dextrose infusion initiated positive benefits in terms of patient well being and postoperative outcome in dogs after panhysterectomy. The favourable outcome of the study recommends preoperative dextrose infusion in dogs for elective surgery as a protocol in future practices in animal surgery.