

# Evaluation of Ropivacaine Tumescence Solution in Surgical Management of Mammary Gland Tumor in Dogs

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## ABSTRACT

Ropivacaine tumescence anaesthesia was evaluated for the surgical management of mammary gland tumors in dogs using a randomized study design involving two groups, each comprising six female dogs diagnosed with mammary tumors. Group I received tumescence infiltration with ropivacaine, adrenaline, and Ringer lactate prior to mastectomy, while Group II underwent excision without tumescence anaesthesia. Intraoperative pain control was assessed via heart rate monitoring and postoperative pain was evaluated with a multidimensional composite pain scale. Dogs treated with ropivacaine tumescence solution showed markedly reduced intraoperative bleeding, stable cardiovascular parameters, and significantly lower pain scores during recovery compared to the control group ( $p < 0.05$ ). The addition of adrenaline enhanced vasoconstriction, further minimizing blood loss and prolonging anaesthetic effect at the surgical site. Ropivacaine tumescence infiltration offered robust and prolonged analgesia, reduced the need for systemic analgesics, and supported smooth postoperative recovery. This technique demonstrates that ropivacaine tumescence anaesthesia is an effective, safe, and practical option for canine oncologic mammary surgery, supporting multimodal anaesthesia protocols for optimal pain control and surgical outcomes.

**Key words:** Dogs, Mammary gland tumor, Ropivacaine, Tumescence anaesthesia.

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## INTRODUCTION

Mammary tumors are some of the most common tumors in dogs, especially in intact females. They represent between 42-54% of all tumors reported in female dogs. The annual incidence rate in female dogs ranges from about 192 to 250 cases per 100,000 dogs (Vascellari *et al.*, 2016). The lifetime risk for an individual female dog developing a mammary tumor is estimated at 23-34%. Mammary tumors are rare in male dogs but can occur (about 2-3% of mammary tumor cases) (Engdahl *et al.*, 2025). Mammary tumors are among the most frequent neoplasia in female dogs, and surgical excision (mastectomy) remains the mainstay of treatment for local tumor control (Tavasoly *et al.*, 2013). Effective peri-operative analgesia and anaesthesia are critical for minimizing surgical pain, optimizing recovery, and improving overall outcomes during these often extensive surgeries. Surgical excision of mammary tumor remains as only best possible option for the treatment. Based on the size and number of the tumor mass the surgical procedure is classified like lumpectomy or nodulectomy, single mastectomy, unilateral mastectomy and bilateral mastectomy (Papazoglou *et al.*, 2014).

Ropivacaine is a long-acting amide-type local anaesthetic valued for its favourable safety profile, lower cardiotoxicity and central nervous system toxicity compared to bupivacaine (Bhat *et al.*, 2013). It offers significant separation between sensory and motor block, which supports better postoperative motor function. Different concentrations of Ropivacaine (e.g.,

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0.05% and 0.1%) have been tested with effective analgesia and minimal side effects (Sanches *et al.*, 2020). Ropivacaine is recognized as one of the commonly used local anaesthetics in veterinary practice for peripheral perineural injections, local infiltration, and nerve blocks in small animals, owing to its relatively long duration, lower toxicity compared to bupivacaine, and good safety profile (Grubb and Lobprise, 2020).

Tumescence anaesthesia involves the infiltration of large volumes of a dilute local anaesthetic solution, typically with a vasoconstrictor (e.g., epinephrine), to produce swelling (tumescence) and firmness of the surgical area. Originally designed for human liposuction, it has since found utility in

veterinary oncologic surgeries with wide excision margins, such as mastectomy for mammary tumors (Sanches *et al.*, 2020). Lower intra-operative bleeding and shorter excision times are reported in dogs receiving tumescent anaesthesia versus intravenous opioids. Superior peri-operative pain control and reduced requirements for rescue analgesia compared to epidural or systemic techniques are reported advantages (Credie *et al.*, 2013). This study was aimed in evaluate Ropivacaine for efficacy in pain management during intra-operative procedure and at post-operative recovery period, and to evaluate the control of intra-operative bleeding.

## MATERIALS AND METHODS

### Selection Criteria

Dogs with mammary tumor without any other systemic diseases were selected for the study purpose. Twelve female dogs with mammary gland tumor that were presented to the Madras Veterinary College, Chennai were selected for the study. These twelve dogs were divided into two groups I and II.

### Preoperative Examinations and Anesthetic protocol

The animals were subjected to physical, radiological and haemato-biochemical evaluations. In physical examination the size, consistency, type of attachment to the base and number of glands affected etc were recorded.

Animals in both the groups were pre-anesthetized with Inj. Diazepam @ 0.25 mg/kg and Inj. Butorphanol @ 0.1 mg/kg intravenously and anaesthesia was induced with Inj. Propofol @ 3.0 mg/kg intravenously. The animals were intubated and anaesthesia was maintained with Isoflurane inhalant anaesthesia. The animals in Group I were administered with tumescent solution around the mammary tumor under general anaesthesia, while the animals in Group II were operated without tumescent solution.

### Intra-Operative Evaluation and Pain Score

The animals were continuously monitored throughout the surgical procedure for heart rate and SpO<sub>2</sub>. The bleeding from the surgical site was recorded in both the groups for visual comparison. The concentration of the inhalant anaesthetic was recorded every ten minutes and the heart rate during painful operating procedure was observed for variations.

The inhalant anaesthetic dose was kept constant in both the groups I and II in order to evaluate the pain response of the animal with and without the tumescent solution. This was indirectly evaluated by monitoring the elevation of heart rate during incision procedures. Also, animals were evaluated during recovery and scored based on the multidimensional composite pain scale (MCPS)(Grant, 2006) (Table 1).

**Table 1:** Intra-operative evaluation of pain score based on heart rate and vocalization in dogs

Variable	Criteria	Score
Heart rate	0-10% greater than pre-op value	0
	11 to 30% greater than pre op	1
	31 to 50% greater than pre op	2
	> 50% greater than pre op	3
Vocalization	No crying	0
	Crying, responsive to calm voice	1
	Crying, not responding to calm voice	2

### Tumescent Solution and its Administration

Tumescent solution to be infiltrated around the tumor mass was prepared freshly with Ropivacaine, adrenaline and Ringer lactate solution, before the surgical procedure. The proportion of the drugs used in the tumescent solution (Abimussi *et al.*, 2014) was Inj. Ringer lactate 450 mL, Inj. Ropivacaine 40 mL, and Inj. Adrenaline 0.5 mL. After inducing the anaesthesia, surgical site was aseptically prepared and tumescent solution was infiltrated around the tumor mass @ dose rate of 15 mL per kg body weight before 15 min of surgical incision using 21G infiltration canula and a syringe (Fig. 1).



**Fig. 1:** Infiltration of Tumescent solution around the tumor mass

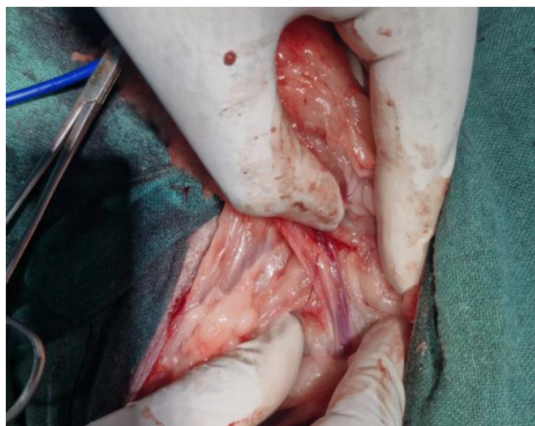
### Monitoring of Vitals

Animals in both the groups I and II were monitored for the vital signs for increase in heart during the painful procedures during the surgery. Heart rate was recorded every 10 min throughout the surgery duration. The concentration of inhalant anaesthesia was marked during the entire procedure, in both the groups I and II.

## RESULTS AND DISCUSSION

Animals in group I in which mastectomy was performed with the infiltration of tumescent solution, the surgical site

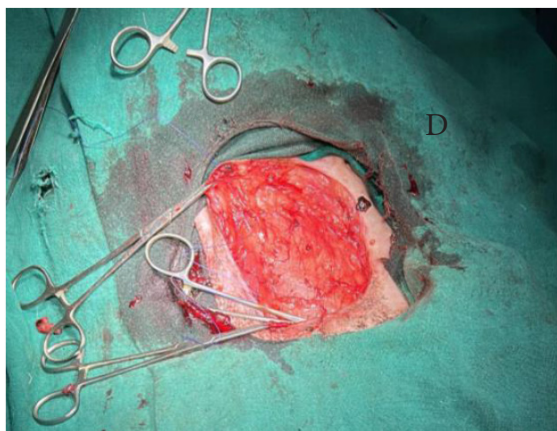
showed vasoconstriction of blood vessels feeding the tumor mass (Fig. 2) and showed controlled or very less bleeding at the surgical site (Fig. 3). In group II, in which excision was performed without tumescent infiltration showed excessive bleeding in the surgical site (Fig. 4).



**Fig. 2:** Vasoconstriction of feeder vessel on tumescent infiltration at infiltration site in group I



**Fig. 3:** Limited or controlled bleeding from the surgical site



**Fig. 4:** Excessive bleeding from surgical site in group II

The adrenaline in the tumescent solution resulted in effective vasoconstriction of the feeder vessels resulting in satisfactory control in bleeding, in turn shortening the time taken for the excision procedure and concurred with the

findings of Credie *et al.* (2013). Vasoconstriction contributes significantly to the localization of ropivacaine at the surgical site, helping maintain a high concentration of the anaesthetic and thus prolonging its local anaesthetic effect. Ropivacaine, especially at low concentrations, possessed inherent vasoconstrictive properties, which reduce local blood flow and limited systemic absorption, resulting in enhanced and prolonged anaesthesia at the desired site (Sung *et al.*, 2012). Ropivacaine itself has long duration of action when compared to other local anaesthetics like lidocaine and bupivacaine (Bhat *et al.*, 2013). Whereas, increased bleeding was observed in group II, due to numerous capillaries feeding the tumor mass, in spite of ligation of major feeder vessels.

**Table 2:** Mean of the heart rate (HR) of animals during surgery in Group I and II

Time (min)	Group I		Group II	
	HR	% increase	HR	% increase
0	89	0	92	0
10	92	3	97	6
20	94	5	133	44
30	91	2	125	36
40	89	0	92	0

During the surgical procedure on an average the heart rates were fluctuating with the normal physiological values and mild rise, *i.e.* two to five percent increase in heart rate was observed during the incision and blunt dissection procedures which indicates that animals intra-operative pain was effectively suppressed by Ropivacaine tumescent infiltration in group I (Table 2). This observation is attributed to the analgesic action of the Ropivacaine tumescent infiltration around the surgical site which coincides with findings of Henze *et al.* (2023), demonstrating effective pain control during surgery. The tumescent solution containing ropivacaine provide satisfactory postoperative analgesia lasting several hours with safe plasma concentrations and comparable efficacy to lidocaine solutions (Abimussi *et al.*, 2014). Animal owners were advised to monitor the pet for signs of pain, for up to 5 h, like frequent looking into the surgical site and vocalization in case of severe pain and if the animal is responding to the calm pacifying voice of the owner. Post-operative analgesic was not administered in any of the groups. In group I, 4 out of 6 animals evinced low pain (0 score), which was exhibited by no crying and 2 animals were crying with pain score 1, but calm down for pacifying voice of pet owner. In group II, 50% of the animals were crying out of pain with score 2, and did not calm down by pacifying voice of owner and other 50% of animals were crying with pain score 1, but calmedown on pacifying voice.

On statistical evaluation, the animals in group I showed significant difference ( $p < 0.0035$ ) in pain reduction when compared with the animals in group II. This was attributed to the presence of local analgesic, Ropivacaine at the surgical site due to vasoconstriction caused by the inj. Adrenaline

present in the tumescent solution, and supported the view of Sung *et al.* (2012).

It is concluded that, Ropivacaine tumescent anaesthesia is an effective, safe, and practical technique for mammary tumor excision in dogs. It offers robust intra-operative and post-operative analgesia, reduces surgical bleeding, minimizes the need for systemic analgesics, and supports smooth recovery. This approach represents an important option in multimodal anaesthesia management for canine oncology surgery.

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