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# Evaluation of tumescent anaesthesia and fentanyl analgesia for mammary tumour excision in dogs

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**Abstract**
Dogs having mammary tumours (unilateral or bilateral) belong to different breeds, aged between 4.5 to 13 years with a body weight ranged between 10 to 44 kgs were utilized for the study. Following premedication dogs were sedated with glycopyrrolate and acepromazine and were subjected to propofol anaesthesia. After stabilization of anaesthesia and monitoring, the animals were divided in to two groups of six animals each. Group I animals were subjected to tumescent anaesthesia and group II animals were given fentanyl analgesia for mammary tumour excision. Physiological, haematological and bio chemical parameters were recorded and analyzed. The mean induction time of propofol was 21± 0.516 seconds in both groups. Induction quality was excellent, smooth and rapid without struggling in all animals. Tumor excision time and intraoperative bleeding was less in dogs subjected to tumescent anaesthesia. TA is apparently safe for use in clinical conditions as it did not produced any adverse signs or lignocaine toxicity and facilitated the surgical procedure because of reduced bleeding and a shorter mammary gland removal time without interfering with wound healing.

**Keywords:** Mammary tumors, tumescent anaesthesia, dogs

## 1. Introduction
Mammary tumours are the most common neoplasms in dogs and mastectomy is the most indicated treatment with the exception of cases of inflammatory carcinoma and metastases. Mastectomy requires extensive tissue resection to achieve a safe, wide margin and avoid recurrence. The literature says that anaesthetic and analgesic techniques for primary cancer surgery influence long term outcomes, elucidating the biology of cancer cells and the perioperative factors that could influence metastasis [16]. Under these circumstances an effective trans-operative and postoperative analgesia is required in canine cancer patients. Tumescent anaesthesia (TA) is a local anaesthetic technique that provides anaesthesia of large areas of skin and subcutaneous tissue by means of the direct infiltration of large volumes of a diluted local anaesthetic solution usually combined with vasoconstrictors into subcutaneous fat. Due to its relative low toxicity, lidocaine is the local anaesthetic that has been most frequently used. Considering the diluted nature of the solution, large amounts of anaesthetic solution may be safely used with little risk of local anaesthetic induced toxicity. The perioperative use of opioids is a traditional practice in oncology. Fentanyl is a potent synthetic opioid with strong agonist properties at mu receptors [6]. Fentanyl is an ultra-short acting agent which has a rapid onset of action and is mainly used as an infusion to provide a continuous level of analgesia. Fentanyl has a wide margin of safety, possesses minimum effects on the cardiovascular and respiratory systems and is readily reversible [6].
There is a paucity of literature available on combination of above anaesthetic drugs and taking into considerations of perioperative anaesthetic and analgesic effects of tumescent anaesthesia and fentanyl, an attempt was made in the present study to evaluate the use of tumescent anaesthesia and fentanyl analgesia in conjunction with general anaesthesia for the surgical excision of mammary tumours in dogs

## 2. Materials and Methods
Dogs having mammary tumours (unilateral or bilateral) belong to different breeds, aged between 4.5 to 13 years with a body weight ranged between 10 to 44 kgs were utilized for the study. All these dogs were randomly selected and routine clinical, haematological and radiological examinations were carried out and those were found to be fit for surgery were

utilized for study. All the dogs under study were premedicated with glycopyrrolate @ 0.011mg/kg body weight subcutaneously. Ten minutes after premedication, the dogs were sedated with acepromazine @ 0.05 mg/kg body weight intramuscularly. Anaesthesia was induced and maintained with propofol @ 5 mg/kg body weight intravenously. After stabilization of anaesthesia and monitoring, the animals were divided in to two groups of six animals each.

In group I, after induction of general anaesthesia and monitoring the dog, tumescent anaesthesia was performed with the animal in dorsal recumbency, by introduction of a multi holed cannula (Fig 1). Large volume of cold tumescent solution (kept at 4$^{o}$c) was infiltrated around the mammary tumour. The infusion of solution was concomitant with the advancement of the cannula (Fig 2).

**Composition of Tumescent solution** [2]

| | | |
|---|---|---|
| Ringers Lactate solution[5] | - | 250 ml |
| Lignocaine 2% [6] | - | 40 ml |
| Adrenaline (1mg/ml) [7] | - | 0.29 ml |
| Sodium bicarbonate 8.4% | - | 16 ml |

Animals in group II, received fentanyl [4] bolus @ 2.5 µg/kg body weight intravenously after inducing general anaesthesia. The character of anaesthesia during induction, surgical plane of anaesthesia and recovery was assessed. Intraoperative evaluation was done by recording the time of tumour removal, total time of surgery, amount of bleeding in each group. Postoperative pain was evaluated in both groups. Physiological parameters like temperature, respiratory rate, pulse rate, heart rate and pulse oximetry values ($SpO_2$) were recorded before and at 5, 10, 15, 30 and 60 minutes time interval. ECG studies and haematological parameters (Hb and PCV) were carried out before, during and after anaesthesia. Serum biochemical parameters (cortisol and glucose) were also estimated before, during, after anaesthesia (HRP), at 2 hrs and 4 hrs intervals after surgery.

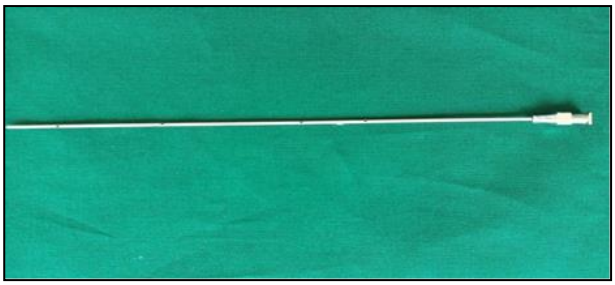

**Fig 1:** Photograph showing multi holed cannula for injecting TA

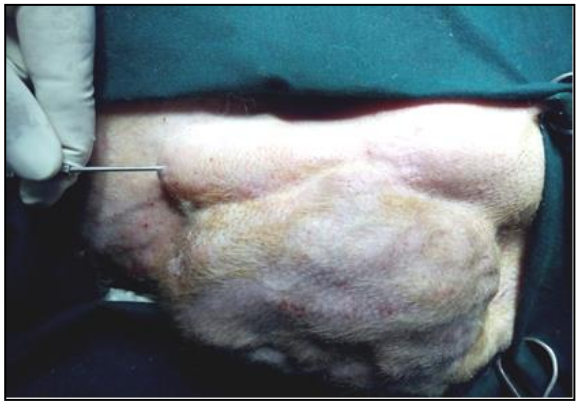

**Fig 2:** Photograph showing injecting TA solution around mammary tumour in a dog

## 3. Results and Discussion

The mean induction time of propofol was 21± 0.516 seconds in both groups. Induction quality was excellent, smooth and rapid without struggling in all animals. Propofol produced good surgical anaesthesia with adequate muscle relaxation and absence of response to surgical manipulation in both groups. There was no significant difference between the groups with regards to time of extubation, head raising and sternal recumbency (Table.1). Recovery was smooth and excitement free in both groups. However, slightly prolonged recovery was a consistent observation in fentanyl group However, smooth but slightly prolonged recovery was a consistent observation in the fentanyl group in our study, which might be attributed that propofol reduced the clearance of fentanyl which is because of inhibition of microsomal enzymes that are responsible for metabolism of fentanyl [1].

Tumour excision time was shorter in group I dogs compared with the animals of group II (Table. 1). There was a significant difference ($P \leq 0.05$) between the groups with respect to tumour excision time and total duration of surgery. The intraoperative bleeding was very less in group I animals than in group II which facilitated better visualization of the operative area, less vessel clamping and easy removal of tumour with minimum bleeding (Fig 3 and 4). This reduced bleeding volume also contributed to the shorter mammary tumour excision time in TA group. When surgical bleeding is reduced, better visualization of the operative area is allowed and less vessel clamping, tissue manipulation and suture material are necessary. Further, bleeding impairs tissue oxygenation and in oncological patients, is an important factor for tumour cell dissemination and immunosuppression.

Postoperatively, two animals in group II developed postoperative seromas which resulted in wound dehiscence. There were no wound healing problems or dehiscence in any animal in TA group. Early suture removal was observed in group I dogs.

In the present study, a significant decrease in RT was recorded in both groups during anaesthesia and surgery. Hypothermia was probably produced by the sedative and anaesthetics used, which decreased RT by depression of thermoregulatory centre, reduced BMR and muscle activity, depression of peripheral circulation and vasodilation [17, 16, 2]. Also observed decrease in RT with TA and fentanyl analgesia in dogs during mastectomy.

A decrease in RR was observed in both groups following premedication and induction of anaesthesia. In the present study respiratory depression was a consistent finding up to 60 minutes interval. These findings were in accordance with the earlier studies in which a greater respiratory depression was observed when propofol was used alone or in combination with opioids in dogs [7, 13, 15]. Propofol caused a decrease in mean RR by depressing central inspiratory drive and the ventilatory response to arterial $CO_2$ tension. In the present study, transient apnoea was observed immediately after propofol induction in both groups [8, 10, 9, 3]. Opined that the depression of afferent activity from the carotid body was probably the under lying cause of respiratory depression and transitory apnoea.

Pulse rate and HR differed significantly between the groups. However, dogs with fentanyl analgesia showed a significant decrease in HR throughout the study. This might be due to the fact that, fentanyl increases parasympathetic tone and leads to vagally mediated bradycardia with minimal effects on myocardial contractility. However, these negative

chronotropic effects depend on dose and speed of administration [14]. The variations in SpO2 between the groups were non-significant. However, all the fluctuations were within the normal physiological range.

Pain scores differed significantly between the groups throughout the period of observation. Pain scoring in the study was performed by an experienced person as suggested by [4]. Results showed that animals in group II exhibited maximum pain score at 6 hours. TA group animals also recorded an increase in the pain scores which were comparatively lesser than fentanyl group. This finding suggested that better postoperative analgesia was attained with TA than with fentanyl. This is in agreement with the findings of [2] who compared TA and fentanyl in conjunction with general anaesthesia in dogs undergoing mastectomy.

ECG studies did not reveal any abnormalities except increased QRS duration in both groups. TA induced tachycardia in dogs with increased amplitude of QRS complex. However, dogs with fentanyl analgesia showed normal HR with increased amplitude of QRS complex. Increased in QRS complex in both groups in our study, indicated delayed ventricular depolarization as reported by [11].

The haematological parameters like Hb and PCV values showed non-significant decrease in both groups. The fluctuations in Hb and PCV were non-significant between the groups. Pooling of circulatory blood cells in the spleen or other reservoirs secondary to decreased sympathetic activity explained the decrease in Hb and PCV. The decrease in Hb and PCV during the period of anaesthesia or sedation might be due to shifting of fluid from extravascular compartment to intravascular compartment in order to maintain normal cardiac output in animals [12, 5, 9].

Clinical correlation of reduction in pain scoring was amply supported by biochemical parameters like cortisol and glucose. The results in the present study also indicated a rise in serum cortisol levels both during general anaesthesia and surgery. Significantly decreased serum cortisol levels were recorded in animals subjected to TA. This indicated that TA effectively took care of pain and stress during surgery under general anaesthesia and postoperatively. This is attributed to the fact that regional anaesthetic technique may attenuate stress response by blocking afferent neuronal input during an early postoperative period. Significant postoperative decrease in serum glucose levels in TA group suggests that TA has provided better postoperative analgesia and was found to be an excellent alternative to fentanyl administration.

Fentanyl depresses natural killer cell activity and stimulates angiogenesis, cell migration and cell proliferation in patients with cancer and therefore increases the occurrence of metastasis. Thus pure agonist opioids should be avoided in patients undergoing oncologic surgeries [2]. In this respect, regional anaesthesia is preferable to the use of general anaesthesia or opioids because it has been shown to reduce tumour recurrence in humans and rodents. Regional anaesthesia attenuates the surgically induced endocrine responses and minimises or spares the use of opioids, improving the immunological response. Lignocaine also inhibits epidermal growth factor receptor activity [2]. Considering that regional anaesthesia improved perioperative analgesia and surgical conditions in this study and taking into account the potential effect of this technique in the postoperative prognosis of oncological patients, TA appears to be a promising technique under these circumstances.

**Table 1:** Mean ± SE values of age, body weight, surgical time and anaesthetic recovery time (in minutes) in dogs of both groups

| Parameter | Group I | Group II | |
|---|---|---|---|
| Age | 9.25+1.34[a] | 8.42+1.38 [a] | 0.67 |
| Weight | 27.83+5.02 [a] | 26.00+3.97 [a] | 0.78 |
| Mammary tumor excision time | 9.83 ± 2.56 [a] | 49.17± 5.83[b] | 0.00 |
| Total surgery time | 28.00 ± 2.94 [a] | 77.50 ± 5.59 [b] | 0.00 |
| Time to extubation | 4.17+0.40 [a] | 3.83+0.48 [a] | 0.61 |
| Time of raising head | 9.33+0.71 [a] | 9.50+0.62 [a] | 0.86 |
| Time to sternal recumbence | 25.00+1.83 [a] | 19.00+4.87 [a] | 0.28 |
| Time to standing | 60.33+2.46 [a] | 61.50+3.74 [a] | 0.80 |
| Time of suture removal (Days) | 11.83+0.40 [a] | 13.33+0.42[b] | 0.03 |

Means bearing different superscripts (a,b,c.) within a row differ significantly ($P \leq 0.05$)

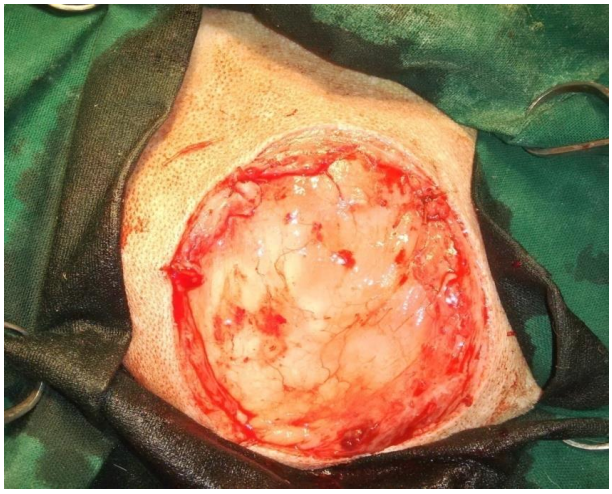

**Fig 3:** Photograph showing less bleeding and better visualization of operative area with TA in a dog

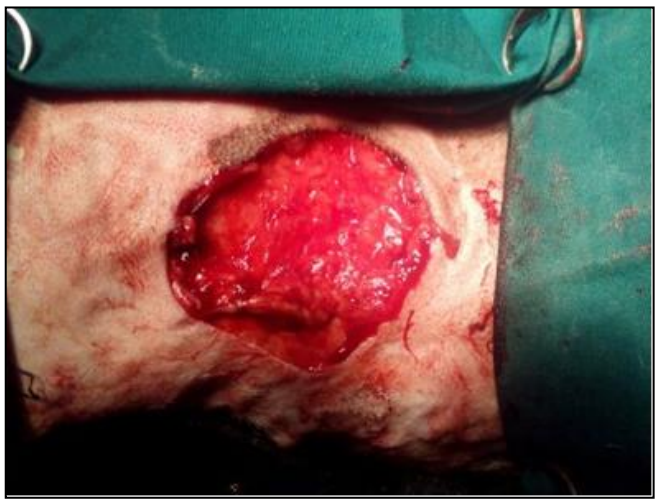

**Fig 4:** Photograph showing more intraoperative bleeding in fentanyl group in a dog

## 4. Conclusions

In conclusion, compared with fentanyl bolus injection, the use of TA in dogs undergoing mastectomy, may be easily performed in non inflammed, ulcerated or adhered mammary tumours with improved transoperative and immediate postoperative analgesia. TA is apparently safe for use in clinical conditions as evidenced by the fact that it did not produce any adverse signs or lignocaine toxicity and facilitated the surgical procedure because of reduced bleeding and a shorter mammary gland removal time without interfering with wound healing.

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