TRACHEAL RECONSTRUCTION IN DOGS UNDER ACEPROMAZINE - THIOPENTAL ANAESTHESIA

By

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THESIS

Submitted in partial fulfilment of the requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
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COLLEGE OF VETERINARY AND ANIMAL SCIENCES
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DECLARATION

I hereby declare that the thesis entitled **Tracheal reconstruction in dogs under acepromazine thiopental anaesthesia** 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 this thesis entitled "Tracheal reconstruction in dogs under acepromazine thiopental anaesthesia" is a record of research work done independently by Kum Angamuthu Jayasudha under my guidance and supervision and that it has not previously formed the basis for the award of any degree fellowship or associateship to her

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ANGAMUTHU JAYASUDHA

Dedicated To My

Experimental Animals

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Introduction

INTRODUCTION

Interference in normal respiratory function in dogs due to narrowing of the tracheal lumen can result from conditions like congenital defects (White and Kellagher 1986) trauma (Hill 1974) mucosal damage secondary to endotracheal intubation (Knecht et al 1972) tracheostomy (Potter et al 1964) tracheal collapse (Slatter and Pettit 1974) and neoplasms occluding the tracheal lumen (Bryan et al 1981) Though respiratory embarrassment may not be evident even with considerable narrowing the chance of development of dyspnea suddenly is high in all these conditions Once clinical signs of respiratory obstruction become evident the critical nature of tracheal function necessitates correction rather than conservative management

Methods of surgical correction recommended include tracheostomy for relief of upper airway obstruction chondrotomy where all the affected rings or alternate rings are cut longitudinally to permit expansion plication of the dorsal membrane (Amis 1974) use of extraluminal or intraluminal prosthetic devices(Leonard and Wright 1978 Watt 1992) and tracheal resection and end to end anastomosis

Partial resection of the tracheal wall creates a defect that may be difficult to repair and the possibility of stricture is significant Circumferential resection and end to end

The objectives of the study are

1 To study the efficacy of acepromazine thiopental anaesthesia for tracheal resection in dogs

2 To study the healing after tracheal resection and end to end anastomosis

3 To study the efficacy of polypropylene mesh prosthesis for tracheoplasty in dogs

Review of Literature

REVIEW OF LITERATURE

Acepromazine and Thiopental anaesthesia

Pugh (1964) reported that in dogs the computed dose of thiopental could be reduced by 48 3 per cent after premedication with acepromazine at the rate of 0 125 mg/kg bodyweight IM The recovery from anaesthesia was smooth

Atamanyuk and Melrose (1965) performed prosthetic reconstruction of the cervical trachea in dogs under intravenous sodium pentothal anaesthesia and recorded that all the animals made an uneventful recovery from anaesthesia

Usenik and Cronkite (1965) determined leucocyte counts packed cell volumes and differential counts in normal and splenectomized dogs after pentobarbital thiopental thiamylal and methohexital anaesthesia They found a decrease in leucocytes in both groups decrease in the packed cell volume in normal animals and found no change in the differential counts in either groups

Popovic et al (1972) reported a decrease in arterial blood pressure an intermittent bradycardia and a decrease in rectal temperature when acepromazine (1 mg/kg) was administered IM in dogs Changes in pH of blood the partial

pressures of oxygen and carbondioxide and the oxygen saturation were not significant

Turner et al (1974) investigated the respiratory and cardiovascular effects of acepromazine chlorpromazine pethidine diethylthiambutene and a mixture of fentanyl droperidol in dogs They found that when acepromazine maleate (0 11 mg/kg) was administered by slow intravenous infusion the full clinical effect was seen within 5 minutes with the duration of effective sedation being 45 minutes There was tachycardia and changes in packed cell volume and hemoglobin concentration were not significant

Mason (1976) observed tachycardia fall in blood pressure bronchospasm cyanosis and death in a dog after premedication with acetyl promazine and atropine sulphate and induction with thiopentone Diffuse haemorrhage was noticed in bowel The dog had a previous exposure to thiopentone

Lang et al (1979) investigated the effect of acetylpromazine (0 07 mg/kg IM) on haematology in six adult dogs and found consistent drop in total erythrocyte count (23%) and 20 per cent fall in total leucocyte count with lymphopenia There was reversal of the effects within 24 hours

Bryan et al (1981) excised a tracheal leiomyoma in the cervical trachea of an aged dog and performed end to end anastomosis under anaesthesia with an ultra short acting barbiturate The author recorded that the animal made an uneventful recovery

Rawlings and Kolata (1983) evaluated cardiopulmonary effects of anaesthesia by thiopental IV or a combination of thiopental and lidocaine IV in dogs There was an increase in heart rate after induction The duration of surgical anaesthesia was significantly less and recovery was rapid in the dogs given the combination thiopental and lidocaine (16 ⁵ ± 4 9 min) than in those given thiopental alone (28 1 ± 3 4 min)

Sharma et al (1983a) induced anaesthesia in dogs with thiopental sodium (25 mg/kg) IV after premedication with atropine sulphate (0 02 mg/kg) IM and xylazine (0 15 mg/kg) IM was administered 10 minutes later to prolong the duration of anaesthesia They reported that in animals with atropine thiopental anaesthesia the duration was 14 75 ± 4 26 minutes and the recovery period was 56 21 ± 3 17 minutes

Sharma et al (1983b) evaluated procaine hydrochloride as a maintenance agent in atropinized dogs anaesthetised with thiopentone sodium (25 mg/kg) IV and found that with thiopentone alone the duration of surgical anaesthesia was 11 75 ± 0 85 minutes

Sharma et al (1983c) induced anaesthesia in atropinized dogs (0 02 mg/kg IM) with thiopental sodium (25 mg/kg) IV and chlorpromazine hydrochloride (1 5 mg/kg IM) was administered 10 minutes after induction They observed significant increase in the heart and respiration rates 5 minutes after induction and decrease in rectal temperature total erythrocyte count total leucocyte count packed cell volume and hemoglobin concentration The values returned to pre administration levels between 24 to 72 hours

Varshney and Kumar (1984) successfully performed tracheal resection and end to end anastomosis in dogs under thiopentone sodium anaesthesia after premedication with atropine sulphate

Hatch et al (1985) sedated groups of atropinized dogs using xylazine hydrochloride (2 2 mg/kg IM) or acepromazine maleate (0 25 mg/kg IM) and anaesthetized them with thiopental IV The authors found that in acepromazine treated dogs the mean dosage of thiopental required for anaesthesia was 15 0 mg/kg

Burren and Mason (1986) premedicated a dog with a mixture of 0 4 mg atropine sulphate and 0 9 mg acepromazine subcutaneously They suspected anaphylaxis to thiopentone on induction of anaesthesia 2 5 hours later with 90 mg of a 2 per cent solution when the dog developed signs of dyspnea

salivation vomition decreased cardiac output and evidence of local irritation about the head and face The authors recorded that the dog had no known previous exposure to the drug

Farver et al (1986) evaluated cardiopulmonary consequences after administration of acepromazine (0 2 mg/kg body weight IV) and of subsequent IV administration of ketamine (10 mg/kg) in dogs and found that the heart rate was not affected by acepromazine and breathing rate was decreased significantly after administration of acepromazine

Robinson et al (1986) compared cardiopulmonary effects anaesthetic effects and recovery rates in Greyhounds and mixed breed dogs under barbiturate anaesthesia Thiopental (15 mg/kg) thiamylal (15 mg/kg) methohexital (10 mg/kg) and Pentobarbital (20 mg/kg) were used They reported that mixed breed dogs recovered quietly from thiobarbiturate anaesthesia and time taken to achieve a standing position were significantly longer with pentobarbital Respiratory depression related to the stage of anaesthesia was produced by all barbiturates They found that PCV decreased significantly from base line between 10 and 120 minutes after thiopental was administered to mixed breed dogs

Turner and Ilkiw (1990a) administered thiopental thiamylal and methohexital in dogs to determine equipotent doses necessary to inhibit laryngeal reflexes They found that

inhibition of laryngoscopic reflex in 50 per cent of the animals was achieved with 19 4 mg of thiopental per kg 18 4 mg of thiamylal per kg and 9 7 mg of methohexital per kg Comparing the potencies of the drugs with thiopental (1) the authors found that thiamylal was equipotent (1 06) and methohexital was twice as potent (2 0) They reported that at the accepted clinical dose recovery times for thiopental (71 1 ± 7 2 minutes) and thiamylal (75 3 + 7 7 minutes) were similar and twice that for methohexital (33 9 ± 4 6 minutes)

Turner and Ilkiw (1990b) studied cardiovascular and respiratory effects of equipotent dose of thiopental sodium (19 4 mg/kg) thiamylal sodium (18 4 mg/kg) and methohexital sodium (9 7 mg/kg) until 12 5 minutes following injection in dogs They found that although all three drugs caused similar changes comparison between the drugs at each time period revealed significant differences They reported that pulse rate varied as 2 of 6 dogs given thiopental and 3 of 6 dogs given thiamylal developed ventricular bigeminy whereas no dog developed dysrhythmias following methohexital administration They found that heart rates were similar with all the three drugs and respiratory depression lasted longer following thiobarbiturate administration

Mansell and Parry (1992) reported that sedation or dogs using acepromazine maleate IV was associated with significant

falls in the PCV and intravenous thiopentone anaesthesia does not exacerbate the reduction of PCV after sedation with acepromazine

Brock (1994) described the properties and use of acepromazine maleate as a tranquilizer and preanaethetic agent Acepromazine causesd transient reduction in packed cell volume and depressed the thermoregulatory center in the hypothalamus which when combined with dilation of cutaneous blood vessels contributed to hypothermia

Techniques of tracheorrhaphy

Ferguson et al (1950) performed experimental evaluation of end to end anastomosis of the trachea in dogs and found that no distressing symptoms occurred when stenosis following repair did not exceed one third of the original tracheal lumen However when stenosis occluded the trachea to one fourth of its normal circumference stridor was observed They recorded that granulomas caused by sutures of silk used in tracheal repair heal as small fibrous protrusions into the lumen

Cantrell and Folse (1961) created circumferential tracheal defects in dogs and performed end to end anastomosis with interrupted sutures using 4 0 braided stainless steel wire Healing was excellent when anastomosis was done under a tension of less than 1 700 grams and respiration was normal in animals

in which primary healing resulted They observed that an extensive collateral vascular plexus provided adequate circulation even after the total ligation of segmental vessels and mobilization of the trachea The authors reported that anastomoses performed at a tension between 1 700 and 2 200 grams yielded unpredictable results and were not successful when the tension was greater than 2 200 grams

Leonard (1971) successfully treated tracheal collapse in seven dogs by bisecting alternate tracheal rings on the ventral midline cutting through the cartilage but leaving the tracheal mucosa intact This technique allowed the muscular portion to draw the severed rings together and the lateral tension of the unaltered rings prevented the trachea from collapsing laterally

Knecht et al (1972) reported the development of tracheal stenosis in a dog following routine endotracheal intubation for surgery The stenosis was attributed to excess inflation of the cuff The stenotic segment was excised and the cut ends were apposed by simple interrupted and horizontal mattress sutures using 00 synthetic suture material Radiographs taken 16 days postoperatively revealed minimal narrowing of the tracheal lumen at the site of anastomosis

Maeda and Grillo (1972) studied tracheal growth following resection and end to end anastomosis in 25 pups They

reported circular narrowing with thickening of the tracheal wall at the anastomotic site

Gordon (1973) reported surgical correction of stricture of the thoracic portion of the trachea in a dog by resection and anastomosis using interrupted sutures of 4 0 silk There was slight narrowing at the site of anastomosis immediately after the operation and a follow up over a 17 month period revealed no further reduction in diameter

Rubin et al (1973) corrected tracheal collapse in 9 dogs using the technique of plication of the dorsal tracheal membrane in order to shorten the gap between the free ends of the tracheal cartilage Of the 9 dogs 7 showed marked improvement

Amis (1974) recorded the occurrence of tracheal collapse in 15 dogs He successfully performed tracheal chondrotomy in 9 dogs and plication of the dorsal tracheal soft tissue in 1 dog

Hill (1974) carried out end to end anastomosis of severed cervical trachea in a dog using simple interrupted sutures of monofilament nylon (000) The dog was free from complications postoperatively

Aron et al (1980) removed a primary tracheal chondrosarcoma from the thoracic trachea in a dog by performing

tracheal resection and end to end anastomosis using monofilament nylon

Lau et al (1980) successfully treated tracheal stenosis in two dogs by performing tracheal resection and end to end anastomosis Retention sutures of 3 0 monofilament nylon and simple interrupted sutures of 4 0 monofilament nylon were used to effect the anastomosis The animals showed normal respiratory function postoperatively The authors opined that in end to end anastomosis with simple interrupted sutures in conjunction with retention sutures the mucosa should be closely apposed without tension in order to assure early epithelialization of the anastomotic site They observed that sutures of silk in tracheal repair caused granulomas

Bryan et al (1981) resected a tracheal leiomyoma in the cervical region of a dog and performed end to end anastomosis using simple interrupted sutures of 4/0 monofilament stainless steel

Harvey and Skyes (1982) resected a tracheal mast cell tumor at the level of the thoracic inlet in a dog and anastomosed the cut ends of the trachea with simple interrupted sutures using 3 0 nylon

Varshney and Kumar (1984) evaluated techniques of tracheal anastomosis in dog by (i) resection at interannular ligament and apposition by simple everting interrupted sutures (ii) resection of half tracheal cartilage leaving the mucosa and uniting by simple interrupted sutures and (iii) circumferential resection and suturing with mattress sutures applied through the overlapped cartilages They opined that placement of retention sutures on either side of the site of resection facilitated easy anastomosis Radiographic evaluation following resection at interannular ligament and anastomosis by simple everting interrupted sutures demonstrated no tracheal stenosis at the anastomotic site Microscopic evaluation revealed continuity of the epithelium at the site of anastomosis on the 15th postoperative day and complete tracheal healing by the 30th postoperative day They concluded that resection at the interannular ligament and apposition by simple everting interrupted sutures was better than the other two techniques for tracheal anastomosis

White and Kellagher (1986) repaired a congenital stenotic segment of the trachea in a dog by resection and end to end anastomosis using 3/0 monofilament polypropylene sutures Radiographs taken 3 months postoperatively revealed a normal tracheal lumen

Kellagher and White (1987) reported the successful repair of cervical tracheal rupture in a dog by tracheal resection and end to end anastomosis using 4/0 polypropylene

Salisbury et al (1990) successfully treated tracheal collapse and bilateral laryngeal paralysis in a dog that had acute onset of dyspnea and cyanosis with an abscess involving the ventral aspect of the trachea immediately caudal to the thoracic inlet Surgical correction was performed after separation of the recurrent laryngeal nerves and resecting the collapsing segment of the trachea End to end anastomosis was performed with simple interrupted sutures using 3 0 polyglactin 910 Radiographs after six weeks indicated slight narrowing of the tracheal lumen but the dog had normal exercise tolerance

Smith et al (1990) repaired a tracheal defect secondary to trauma in a dog by resection and end to end anastomosis using interrupted sutures of 2 0 polydioxanone One month later the animal showed progressive exercise intolerance moist productive cough and dyspnea Radiographs indicated narrowing and tracheoscopy revealed a 360 degree stenotic lesion at the site of anastomosis The stenotic tracheal segment was resected and end to end anastomosis with simple interrupted sutures using 4 0 polypropylene was done The dog was free from complications postoperatively and radiographs after one month showed improved tracheal diameter

Kınjavdekar and Chaudhary (1991) evaluated repaır of cırcumferentıal defects of the cervıcal trachea ın dogs by sımple ınterrupted sutures and ınterrupted mattress sutures usıng chromıc catgut (3/0) and sılk (3/0) based on the gross and radıographıc changes They observed that adhesıons occurred between the anastomotıc sıte and surroundıng tıssue at one week postoperatıvely and subsıded subsequently when catgut sutures were used ın eıther of the suturıng technıques and no adhesıons occurred when sılk sutures were used Radıography at the sıte of anastomosıs demonstrated slıght narrowıng when ınterrupted mattress sutures were used and no stenosıs when sımple ınterrupted sutures were used They concluded that tracheal anastomosıs usıng sımple ınterrupted sutures wıth chromıc catgut (3/0) produced better results

Kınjavdekar et al (1992) performed hıstomorphologıcal evaluatıon of sımple ınterrupted and ınterrupted mattress sutures wıth chromıc catgut and sılk after experımental cırcumferentıal resectıon and end to end anastomosıs ın dogs Tractıon sutures were placed prıor to anastomosıs to prevent retractıon of the cut ends of the trachea They observed that the epıthelıum at the anastomotıc sıte comprısed of low cuboıdal cells at one week and pseudostratıfıed columnar cells at three weeks postoperatıvely They concluded that sımple ınterrupted suturıng technıque was superıor to mattress pattern and that catgut was superıor to sılk for tracheal reconstructıon

Tracheoplasty

Jackson et al (1950) evaluated the efficacy of homogenous tracheal transplants in the repair of experimentally created tracheal defects in dogs and found that small defects could be successfully repaired with the technique

Bucher et al (1951) repaired experimentally created tracheal and bronchial defects in dogs using stainless steel wire mesh placed extraluminally They observed that extraluminal placement of tracheal prostheses though technically difficult to perform was more suitable than intraluminal placement The authors reported encouraging results in the reconstruction of the cervical trachea but mortality rate was high in thoracic tracheal reconstruction

Davies et al (1951) reconstructed tracheal defects with fresh and preserved homologous tracheal grafts in experimental dogs Cervical and thoracic homologous grafts were supported by acrylic tube held in position with stainless steel wire sutures They found that stenosis occurred within one to three weeks of implantation when circumferential defects were repaired using grafts without any internal support

Craig et al (1953) used polyethylene tube prosthesis to reconstruct experimentally created tracheal defects in dogs and found that stenosis and pneumonia were the common complications

Keshishian et al (1956) studied tracheal reconstruction in dogs using tissue grafts lucite tubes steel wire coil tantalum and stainless steel mesh They reported that when rigid prostheses were used and when the entire circumference of the trachea was replaced the results were not satisfactory but the incidence of stenosis decreased when part of the trachea was replaced

Sato et al (1957) repaired experimentally created tracheal defects in dogs by transplanting laminated costal cartilage whole costal cartilage costal periosteum or rib on a temporary prosthesis of polyethylene tube They found that rib grafts provided best supporting strength and whole costal cartilage was next in order Laminated costal cartilage and the costal periosteum were not satisfactory Following tracheal reconstruction the tendency for abnormal fibroplasia leading to tracheal stenosis was more when the process of inflammation was stronger They opined that better results could be obtained with the use of cortisone to limit the abnormal proliferation of connective tissue which causes tracheal stenosis

Taber and Tomatis (1958) fabricated a tracheal substitute made of compressed polyvinyl formalinized sponge (Ivalon sponge) with a stainless steel coil for internal support to repair experimental tracheal defects in dogs They evaluated 3 techniques and found that a tension relieving suture with

strips of Ivalon sponge produced satisfactory results Postoperative complications such as anastomotic dehiscence tracheal stenosis and ulceration of the esophagus were observed

Beall Jr et al (1962) created circumferential defects in the cervical trachea in 21 dogs and reconstructed the trachea with open heavy Marlex mesh made into tubes sutured inside the tracheal ends using interrupted sutures Eight animals died after surgery due to postoperative stenosis and anastomotic dehiscence Stenosis of the graft was due to ingrowth of fibrous connective tissue when epithelialization was delayed due to persistence of inflammatory reaction In six of the animals heavy Marlex mesh functioned satisfactorily

Potticha and Lewis (1962) used a steel mesh cylinder lined with autogenous fibrocollagenous tissue to replace segments of the cervical trachea in dogs All the animals survived and there was no displacement of the prosthesis 3 to 6 months postoperatively When thin teflon ring was placed within the cylinder to provide additional support scar tissue developed against the rings and caused narrowing of the tracheal lumen

Beall et al (1963) created circumferential tracheal defects in 31 dogs and reconstructed the trachea using tubes made of heavy Marlex mesh The graft was sutured onto the severed tracheal ends with interrupted Marlex sutures The grafts and anastomoses were sealed by wrapping with hemostatic

gauze or the grafts were wrapped prior to insertion with fine knitted Marlex mesh Previously created pleural flaps were used to cover the wrapped grafts in two layers Twelve animals died due to anastomotic dehiscence with progressive stenosis pneumothorax and pneumonia They concluded that heavy Marlex mesh was satisfactory as a substitute for tracheal tissue in circumferential defects when the defect was too large for primary repair

Shaff (1963) repaired cervical tracheal defects caused by animal bites in a dog using a non suture technique with methy 2 cyanoacrylate monomer applied around the perimeter of the debrided wound and an autographic femoral fascia patch was placed over the defect Digital pressure for 60 seconds effected a firm union with the cartilage of the trachea and the tight membrane like graft enhanced respiration without complications

Schiller et al (1964) implanted a piece of plastic to encompass the compressed portion of the trachea in two dogs with tracheal collapse The author opined that though this procedure provided adequate relief excitement and excessive activity caused dyspnea

Atamanyuk and Melrose (1965) conducted a comparative evaluation of four tracheal prostheses in dogs viz non porous polyethylene tube small Dacron mesh tube reinforced with stainless steel rings large Teflon mesh tube reinforced with

heat sealed polypropylene rings and a large Teflon mesh tube reinforced with heat sealed polypropylene rings with temporarily inserted polypropylene tube The prosthesis of large Teflon mesh and heat sealed polypropylene rings with temporarily inserted polypropylene tube gave better results

Gourley et al (1970) successfully excised a tracheal osteochondroma in a dog and repaired the tracheal defect using Teflon mesh anchored to the annular ligament with stainless steel sutures and the muscle tissue was sutured around the Teflon mesh

Furneaux (1973) reconstructed a cervical tracheal defect 2 5 cm long and 1 0 cm wide in a dog using an onlay graft of knitted polypropylene mesh Three months after surgery there was no evidence of tracheal stenosis graft rejection or tracheal collapse in the animal

Marshak et al (1973) reconstructed experimentally created circumferential tracheal defects in nine dogs using full thickness section of the urinary bladder A silastic tubing was used as stent Five dogs died within a month and four dogs remained in good health before and after stent removal and bronchoscopy revealed no stenosis or granulation tissue

Slatter and Pettit (1974) reported successful correction of tracheal collapse in a dog following application of

supporting teflon ring prostheses when tracheal chondrotomy was found ineffective in relieving the condition

Thomas (1977) studied repair of experimentally created tracheal defects in dogs by end to end anastomosis and by reconstruction with grafts of collagen and mesh prostheses of polythene and stainless steel The author recorded that horizontal mattress sutures were ideal for fixing prosthetic material in situ Collagen grafts were unsuitable and polythene mesh was satisfactory in repair of partial defects while stainless steel mesh was unsuitable and end to end anastomosis was ideal in repair of circumferential defects of the trachea

Bright (1981) reported that Marlex mesh used in the repair of body wall defects in dogs gets firmly incorporated by infiltration of its interstices with fibrous tissue

Papp et al (1985) evaluated composite intercostal muscle flaps in the repair of experimentally created intrathoracic tracheal defects in dogs Intercostal muscle flap was good for small patch defects on the trachea

Fingland et al (1989) compared the clinical and pathologic effects of total ring prostheses and polypropylene spiral prostheses applied to the cervical and thoracic portions of the trachea of dogs using a combined lateral thoracotomy and ventral cervical midline approach The authors recorded

that the lateral pedicles were completely dissected from the trachea to facilitate application of polypropylene spiral prostheses to the cervical and thoracic portions of the trachea and observed that the thin sheet of well vascularised connective tissue, covering the entire trachea on necropsy, may be due to reformation of the segmental blood supply to the trachea They concluded that polypropylene spiral prostheses and total ring prostheses applied to the cervical and thoracic portions of the trachea of dogs were well tolerated and produced minimal tissue response during the period of study

Watt (1992) applied spiral shaped extraluminal polypropylene prostheses to the cervical and thoracic trachea in a dog with tracheal collapse The prostheses was sutured onto the tracheal cartilage and dorsal trachealis muscle using 4 0 polypropylene sutures Radiographs taken one month postoperatively showed a widened tracheal lumen

Materials and Methods

MATERIALS AND METHODS

Twelve apparently healthy adult nondescript dogs of either sex were selected for the study They were randomly divided into two groups viz Group I and Group II consisting of six animals each

The dogs within each group were numbered as

Group I A1 A2 A3 A4 A5 A6

Group II B1 B2 B3 B4 B5 B6

The dogs were dewormed and screened for blood parasites and were kept under observation for a period of one week All the dogs were maintained under identical conditions of feeding and management throughout the period of observation

The experiments were conducted as described herein

In Group I circumferential resection of two adjacent tracheal rings of the cervical trachea was performed and the trachea was reconstructed by end to end anastomosis In Group II circumferential resection of two adjacent tracheal rings of the cervical trachea was performed and the trachea was reconstructed with Marlex mesh*

*Bard Marlex Mesh Monofilament knitted polypropylene Bard Vascular Systems Division C R Bard Inc USA

Preoperative consideration

All the animals were prepared by with holding food for 24 hours and water for 12 hours prior to the experiment The mid ventral cervical region from the larynx to the manubrium sterni was prepared for aseptic surgery The site was painted with Tr iodine

Preparation of the prostheses

Marlex mesh was cut into pieces of 2 5 cm x 7 0 cm size Each piece of mesh was individually wrapped and sterilized by autoclaving

Anesthesia

The animals were premedicated with acepromazine maleate* at the dose of 0 02 mg/kg bodyweight intramuscular After a period of 30 minutes anaesthesia was induced with 2 5 per cent solution of thiopentone sodium** intravenously to effect The animals were intubated with Magill s cuffed endotracheal tube and were secured in dorsal recumbency

* Acetylpromazine Acepromazine maleate 20 mg/ml The Boots Company Ltd Nottingham England

** Intraval sodium Thiopentone Injection I P Rhone Poulenc (India) Ltd Bombay

Surgical Technique

Approach to the cervical trachea

An 8 cm long skin incision was made on the midline between the larynx and manubrium sterni. The trachea was exposed by separating the sternohyoideus and sternothyroideus muscles at the midline. The trachea was separated from the surrounding tissue by blunt dissection.

The endotracheal tube was retracted proximally to allow the placement of two traction sutures using 3/0 silk on the ventral aspect of the trachea through the interannular ligaments, two cartilage rings proximal and distal on either side to those cartilages resected. Circumferential resection of two tracheal rings was done by making 360 degree cuts through the interannular ligament.

Reconstruction of the trachea was performed as described below.

Group I

The cut ends of the trachea were approximated with the aid of the previously placed traction sutures. End-to-end anastomosis was performed with simple interrupted sutures using 3/0 silk. Exposure of the tracheal cut ends was effected by

traction on the sutures. Suturing commenced from the dorsal surface of the trachea with the sutures involving entire thickness of dorsal tracheal membrane and placing the knots on the external surface. The subsequent sutures were taken on either side of the first suture. The sutures were placed 0.5 cm apart on either side of the first suture, through the interannular ligament to encompass either cartilage ring of the apposing segments (Fig.1). The endotracheal tube was inserted beyond the site of resection and the sutures were tightened to complete the anastomosis (Fig.2). The muscles and subcutaneous tissue were apposed with simple interrupted sutures using 1/0 catgut. The skin incision was closed by vertical mattress sutures with monofilament nylon.

Group II

Marlex mesh (2.5 cm x 7.0 cm) was made into a tube slightly bigger than the size of the trachea by suturing its ends in a continuous mattress pattern using 3/0 silk. The Marlex tube was fixed to the distal tracheal segment by preplacing four horizontal mattress sutures with 3/0 silk on the dorsal, ventral and lateral aspects of the trachea and the Marlex tube. The suture bites were taken on the annular ligament at a distance of one tracheal cartilage away from the cut ends, without penetrating the tracheal mucosa. The sutures were tightened to draw and secure the Marlex tube over the tracheal surface

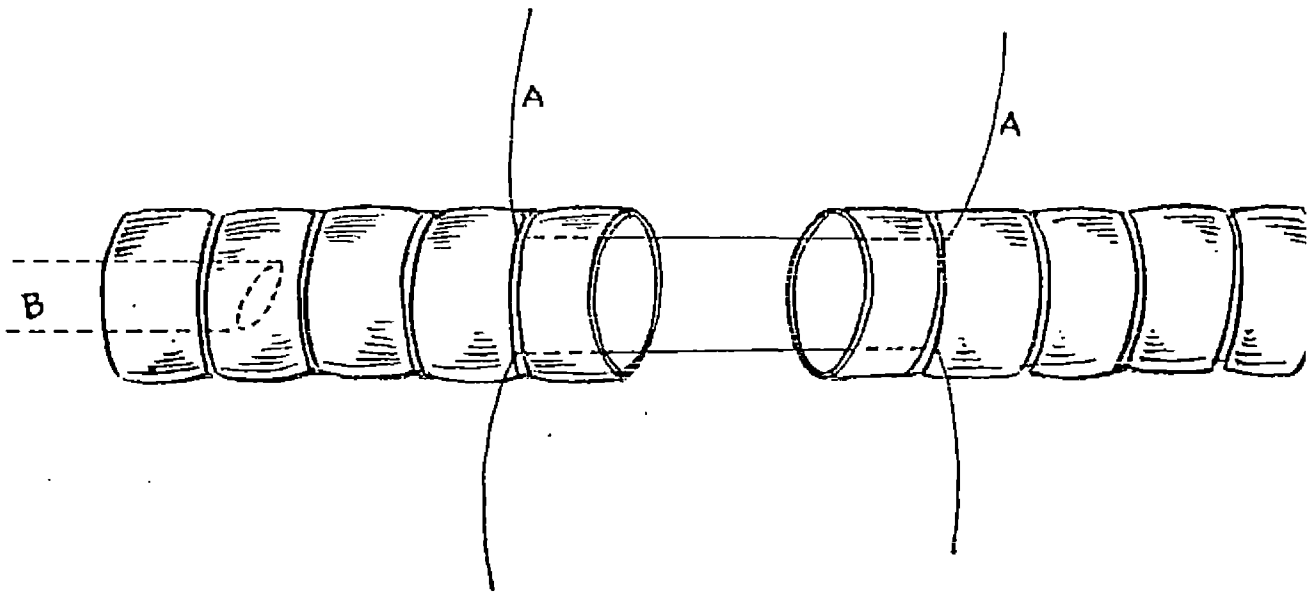
Fig.1. Schematic representation of the surgical technique of end-to-end anastomosis of the trachea

A. Simple interrupted sutures penetrating the interannular ligaments

B. Endotracheal tube retracted to a point cranial to the site of resection

Fig.2. Schematic representation of completed end-to-end anastomosis of the trachea

A. Simple interrupted sutures have been placed to encompass one tracheal cartilage on either side of the anastomosis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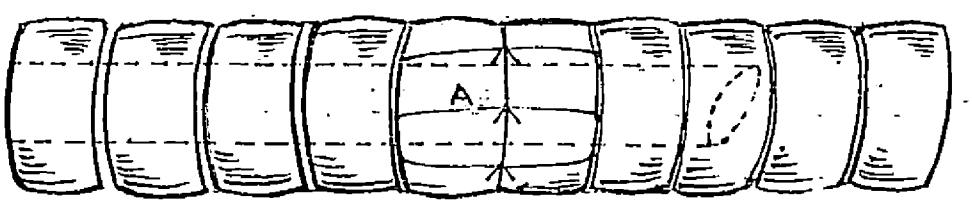
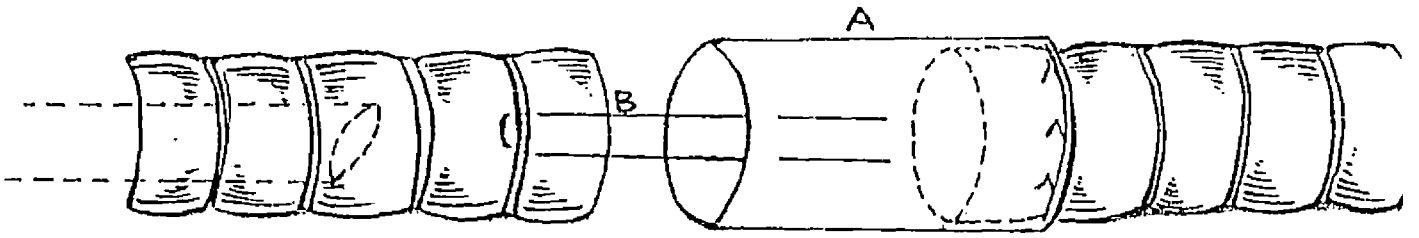

A

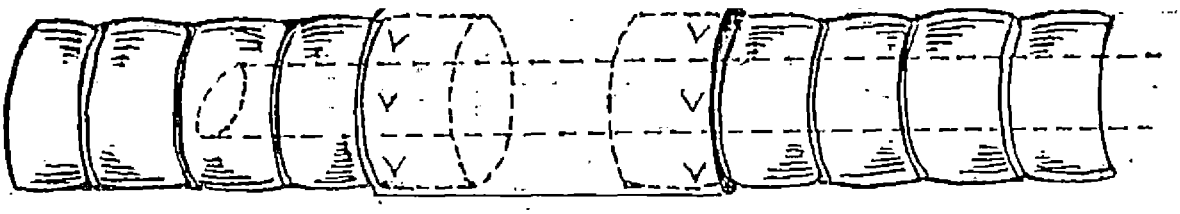
Fig.3. Method of securing prosthesis to the trachea

A. Marlex mesh prosthesis

B. Horizontal mattress suture

Fig.4. Schematic representation of prosthesis in position


A
B



(Fig.3). The tube was sutured in a similar manner to the proximal tracheal segment and the endotracheal tube was inserted beyond the site of reconstruction through the prosthesis (Fig.4). A piece of sterile absorbable gelatine sponge* was wrapped around the prosthesis. The muscles and subcutaneous tissue were apposed with simple interrupted sutures using 1/0 catgut and the skin with vertical mattress sutures using monofilament nylon.

Venous blood samples were collected for haematological studies before and immediately after the induction of anaesthesia, at 24 hours and on the 3rd, 5th, 7th and 15th postoperative days.

Postoperative care

The dogs were kept under observation for a maximum period of 45 days postoperatively.

The wound was dressed daily with nitrofurazone ointment**. All the animals were treated with streptopenicillin 0.5 g*** administered intramuscular for five postoperative

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* Ab Gel- Absorbable gelatine sponge, Sri Krishna Laboratories, Bombay.

** Furacin - Vet Soluble Ointment - Nitrofurazone B.P. (Vet), Smith Kline Beecham Parmaceuticals, Bangalore

*** Dicrysticin-S - Streptopenicillin for suspension, Sarabhai Chemicals, Baroda

days. Dexamethasone**** (0.5 mg/kg body weight) was administered intramuscular for three postoperative days.

Main items of observation

The following parameters were recorded:

(i) Time for induction of anaesthesia: It was calculated as the time interval between the administration of thiopentone sodium and the disappearance of pedal reflex.

(ii) Duration of anaesthesia: It was calculated as the time interval between the disappearance of pedal reflex and the reappearance of pedal reflex.

(iii) Time of recovery from anaesthesia: It was calculated as the time from reappearance of pedal reflex to the time when the animal was able to stand on its own.

(iv) Physiological parameters, such as rectal temperature (°F), pulse rate (per minute) and respiratory rate (per minute) before and after induction of anaesthesia and at 24 hours intervals for five days postoperatively.

**** Dexasone - Dexamethasone phosphate injection, Alved Pharma and Foods Pvt. Ltd., Madras

(v) Clinical evaluation: The surgical wound was examined daily and the animals were observed for postoperative complications, if any.

(vi) Hemogram: Estimation of the total erythrocyte count, the total and differential leucocyte count (Schalm, 1975), packed cell volume (Wintrobe, 1961) and hemoglobin content (Schalm, 1975) was carried out using the blood samples collected.

(vi) Radiographic evaluation: Lateral radiographs of the neck and cervical trachea were taken on the 3rd, 7th, 15th, 30th and 45th day postoperatively. Contrast study of the trachea was performed after intratracheal injection of 1.5 to 2 ml iohexol*. After sacrificing the animals radiographs of the trachea were taken introducing barium sulphate suspension or plaster of Paris powder.

(vii) Gross examination of the trachea was performed at necropsy and the changes at the site of reconstruction, if any, were recorded.

(viii) Histopathological examination: Specimens of the trachea including the site of anastomosis were collected and fixed in formol saline. The fixed tissues were processed

(Armed Forces Institute of Pathology, 1968) and sections 5 u thick were prepared and stained with Haematoxylin and eosin (Sheehan and Hrapchak, 1980).

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* Omnipaque - Iohexol injection, Nycomed Imaging As, Oslo, Norway

Results

RESULTS

The observations are presented in Tables 1 to 9

The average bodyweight of the animals was 11 37 + 0 60 kg Acepromazine maleate was administered to the animals at the rate of 0 02 mg/kg bodyweight intramuscularly Anaesthesia was induced with 2 5 per cent solution of thiopentone sodium intravenously to effect

OBSERVATIONS DURING ANAESTHESIA

The average dose of acepromazine maleate required was 2 29 ± 0 11 mg and the average quantity of thiopentone sodium administered was 257 29 ± 10 04 mg (i e 22 63 mg/kg bodyweight) (Table 1)

The induction time was 3 26 ± 0 10 minutes The duration of anaesthesia was 65 00 + 3 29 minutes and the time taken for recovery was 192 91 ± 13 68 minutes (Table 2)

(i) Physiological parameters (Table 3)

a Rectal temperature (°F)

The rectal temperature (°F) was 102 10 ± 0 20 before anaesthesia and 101 13 + 0 21 immediately after the induction of anaesthesia

Table 1 Body weights of dogs dose of acepromazine maleate and quantity of 2 5% thiopentone sodium administered for surgical anaesthesia

Number of animal	Body weight (kg)	Acepromazine maleate (mg)	2 5% Thiopentone sodium (mg)
1	13 00	2 6	300 00
2	12 50	2 5	250 00
3	8 00	1 6	200 00
4	14 50	2 9	237 50
5	11 00	2 2	200 00
6	9 50	1 9	262 50
7	14 50	2 9	237 50
8	10 50	2 1	262 50
9	8 50	1 9	250 00
10	12 50	2 5	312 50
11	12 50	2 5	275 00
12	9 5	1 9	300 00
Mean ± S E	11 37± 0 60	2 29± 0 11	257 29± 10 04

Table 2 Induction time duration and recovery from acepromazine thiopentone anaesthesia in dogs

Number of animal	Induction time (min)	Duration (min)	Recovery (to standing) (min)
1	4 00	47	125
2	3 30	70	160
3	3 00	50	200
4	3 00	82	165
5	3 00	58	240
6	3 30	55	120
7	3 30	78	250
8	3 30	60	235
9	3 00	65	150
10	3 00	62	230
11	3 00	83	180
12	4 00	70	260
Mean ± S E	3 26± 0 10	65 00± 3 29	192 91± 13 68

A slight decrease in rectal temperature was noticed after the induction of anaesthesia

b Pulse rate (per minute)

The pulse rate was 102 66 ± 4 00 before anaesthesia and 117 91 + 7 08 immediately after the induction of anaesthesia

A marked increase in pulse rate was noted after the induction of anaesthesia

c Respiration rate (per minute)

The respiration rate was 30 00 ± 1 82 before anaesthesia and 10 25 ± 1 25 immediately after the induction of anaesthesia

A marked decrease in respiratory rate was observed after the induction of anaesthesia

(ii) Haemogram (Table 3)

a Hemoglobin content (g/dl)

The hemoglobin content was 15 40 ± 0 67 before anaesthesia and 13 45 ± 0 66 immediately after the induction of anaesthesia

A slight reduction in the hemoglobin content was noted after the induction of anaesthesia

b Packed cell volume (per cent)

The packed cell volume was 41 83 ± 1 44 before anesthesia and 35 58 ± 1 51 immediately after the induction of anaesthesia

A considerable decrease in the packed cell volume was seen after the induction of anaesthesia

c Total erythrocyte count (x 10^6/cu mm)

The total erythrocyte count was 7 61 ± 0 28 before anaesthesia and 6 80 ± 0 25 immediately after the induction of anaesthesia

A considerable decrease in the total erythrocyte count was observed after the induction of anaesthesia

d Total leucocyte count (x 10^3/cu mm)

The total leucocyte count was 17 02 ± 1 65 before anaesthesia and 15 85 ± 1 32 immediately after the induction of anaesthesia

A slight decrease in the total leucocyte count was noted after the induction of anaesthesia

e Neutrophil count (per cent)

The neutrophil count (per cent) was 75 58 ± 1 45 before anaesthesia and 76 50 ± 1 29 immediately after the induction of anaesthesia

A slight increase in the neutrophil count was noticed after the induction of anaesthesia

f Lymphocyte count (per cent)

The lymphocyte count was 20 66 ± 1 60 before anaesthesia and 19 91 + 1 51 immediately after the induction of anaesthesia

A slight decrease in the lymphocyte count was seen after the induction of anaesthesia

g Monocyte count (per cent)

The monocyte count was 1 83 ± 0 19 before anaesthesia and 1 63 ± 0 28 immediately after the induction of anaesthesia

The monocyte count did not show much variation after the induction of anaesthesia

h Eosinophil count (per cent)

The eosinophil count was 1 91 ± 0 27 before anaesthesia and 2 08 ± 0 34 immediately after the induction of anaesthesia

Table 3 Physiological parameters and haemogram in dogs under acepromazine thiopentone anaesthesia

(Mean ± SE)

Parameters	Interval and units	
	BA	AA
Rectal temperature (°F)	102 10 ± 0 20	101 13 + 0 21
Pulse rate (per minute)	102 66 ± 4 00	117 91 ± 7 08
Respiratory rate (per minute)	30 00 ± 1 82	10 25 + 1 25
Hemoglobin content (g/dl)	15 40 ± 0 67	13 45 ± 0 66
Packed cell volume (%)	41 83 ± 1 44	35 58 + 1 51
Total erythrocyte count (10^6/cu mm)	7 61 ± 0 28	6 80 ± 0 25
Total leucocyte count (10^3/cu mm)	17 02 ± 1 65	15 85 ± 1 32
Neutrophil count (%)	75 58 ± 1 45	76 50 + 1 29
Lymphocyte count (%)	20 66 ± 1 60	19 91 ± 1 51
Monocyte count (%)	1 83 ± 0 19	1 63 ± 0 28
Eosinophil count (%)	1 91 ± 0 27	2 08 ± 0 34
Basophil count (%)	0 00	0 00

BA Before anaesthesia

AA Immediately after the induction of anaesthesia

A slight increase in the eosinophil count was seen after the induction of anaesthesia

POSTOPERATIVE OBSERVATIONS

(i) Clinical evaluation (Tables 4 and 5)

Group I

All the animals in this group made an uneventful recovery Dogs A3 and A5 developed slight postoperative edema at the site of skin incision which subsided by the 5th postoperative day Dog A1 developed a swelling at the site of operation on the day after surgery The swelling increased in size progressively and was found to contain serous exudate which was aspirated on the 7th and 10th postoperative days

All the dogs had normal respiratory function throughout the period of observation

Group II

All the animals is this group except dog B6 developed severe complications postoperatively

Leakage of air from the mesh was not clinically significant in any of the animals except in dog B5 which developed subcutaneous emphysema following anastomotic dehiscence Marked stridor and respiratory distress was observed

in four dogs (B1 B2 B3 and B4) Respiratory distress was progressive and the animals died on the 13th (B4) 14th (B1 and B3) and 22nd (B2) day postoperatively

Dog B1 had vomition and diarrhoea at 24 hours postoperatively and vomition was observed on different postoperative days

Dog B5 was fee from signs of respiratory distress until it developed subcutaneous emphysema on the 8th postoperative day The dog died on the 9th postoperative day

Dog B6 was the only animal in this group that showed no abnormalities in respiration or behaviour throughout the period of observation

(ii) Physiological parameters (Tables 6 and 7)

a Rectal temperature (°F)

In Group I the rectal temperature was 101 63 ± 0 24 at 0 minutes 102 10 ± 0 26 at 24 hours 101 50 ± 0 30 on the 2nd day 102 16 ± 0 15 on the 3rd day 101 70 ± 0 13 on the 4th day and 101 63 ± 0 16 on the 5th day

In Group II the rectal temperature was 102 56 ± 0 17 at 0 minutes 102 46 ± 0 12 at 24 hours 101 93 ± 0 18 on the 2nd day 102 30 ± 0 11 on the 3rd day 102 40 ± 0 13 on the 4th day and 102 06 ± 0 14 on the 5th day

Table 4 Clinical evaluation following tracheal resection and end to end anastomosis (Group I)

Number of animal	Clinical observations	Day of Sacrifice/ death postoperatively
A1	No abnormalities in respiration or behaviour of the animal	45th day Sacrificed
A2	No abnormalities in respiration or behaviour of the animal	45th day Sacrificed
A3	No abnormalities in respiration or behaviour of the animal	30th day Sacrificed
A4	No abnormalities in respiration or behaviour of the animal	30th day Sacrificed
A5	No abnormalities in respiration or behaviour of the animal	15th day Sacrificed
A6	No abnormalities in respiration or behaviour of the animal	15th day Sacrificed

Table 5 Clinical evaluation following tracheal resection and reconstruction with Marlex mesh (Group II)

Number of animal	Clinical observations	Day of Sacrif ce/ death postoperatively
B1	Marked stridor and respiratory distress developed on the 9th postoperative day Respiratory distress was progressive Vomition and diarrhoea were observed 24 hours postoperatively	14th day died
B2	Stridor and respiratory distress developed on the 7th post operative day Respiratory distress was progressive Vomition was observed on the 12th postoperative day Rhonchi developed on the 17th postoperative day	22nd day died
B3	Marked stridor developed on the 3rd postoperative day Respiratory distress developed on the 5th post operative day and was progressive Vomition was seen on the 5th post operative day	14th day died
B4	Stridor and respiratory distress developed on the 5th postoperative day Respiratory distress was progressive and wheezing was observed Rhonchi developed on the 12th postoperative day	13th day died
B5	No abnormalities in respiration or behaviour were recorded till the 7th postoperative day Subcutaneous emphysema developed on the 8th postoperative day	9th day died
B6	No abnormalities in the respiration or behaviour of the animal	45th day Sacrificed

The rectal temperature did not show marked variation on different postoperative days in both the groups

b Pulse rate (per minute)

In Group I the pulse rate was 98 50 ± 4 78 at 0 minutes 102 83 ± 8 11 at 24 hours 92 66 + 2 43 on the 2nd day 84 16 ± 5 67 on the 3rd day 92 50 ± 2 68 on the 4th day and 96 00 ± 2 99 on the 5th day

In Group II the pulse rate was 106 83 ± 5 96 at 0 minutes 94 80 ± 6 97 at 24 hours 84 66 ± 3 67 on the 2nd day 90 66 + 4 58 on the 3rd day 97 33 + 4 53 on the 4th day and 96 66 ± 4 63 on the 5th day

In Group I the pulse rate showed increase at 24 hours postoperatively decrease on subsequent postoperative days and was near normal value on the 5th postoperative day

In Group II the pulse rate showed a marked decrease at 24 hours postoperatively which persisted upto the 5th postoperative day

c Respiration rate (per minute)

In Group I the respiration rate was 31 50 ± 2 02 at 0 minutes 41 83 ± 2 47 at 24 hours 40 33 ± 2 72 on the 2nd day 36 00 ± 2 24 on the 3rd day 36 00 ± 1 33 on the 4th day and 33 83 ± 2 16 on the 5th day

Table 6 Physiological parameters on different postoperative days in dogs (Group I)

Parameters and units	Intervals					
	0 min	24 h	2nd day	3rd day	4th day	5th day
Rectal temperature (°F)	101 63± 0 24	102 10± 0 26	101 50± 0 30	102 16± 0 15	101 70± 0 13	101 63± 0 16
Pulse rate (per minute)	98 50± 4 78	102 83± 8 11	92 66± 2 43	84 16± 5 67	92 50± 2 68	96 00± 2 99
Respiration rate (per minute)	31 50_ 2 02	41 83± 2 47	40 33± 2 72	36 00± 2 24	36 00± 1 33	33 83± 2 16

Table 7 Physiological parameters on different postoperative days in dogs (Group II)

Parameters and units	Intervals					
	0 min	24 h	2nd day	3rd day	4th day	5th day
Rectal temperature (°)	102 56± 0 17	102 46± 0 12	101 93± 0 18	102 30± 0 11	102 40± 0 13	102 06± 0 14
Pulse rate (per minute)	106 83± 5 96	94 80± 6 97	84 66± 3 67	90 66± 4 58	97 33± 4 53	96 66± 4 63
Respiration rate (per minute)	28 50± 2 90	34 50± 1 28	46 16± 4 14	45 66± 1 67	43 83± 1 64	49 50± 6 11

In Group II the respiration rate was 28 50 ± 2 90 at 0 minutes 34 50 ± 1 28 at 24 hours 46 16 ± 4 14 on the 2nd day 45 66 ± 1 67 on the 3rd day 43 83 ± 1 64 on the 4th day and 49 50 ± 6 11 on the 5th day

In Group I the respiration rate showed a marked increase at 24 hours postoperatively which persisted on the subsequent postoperative days and was near normal value on the 5th postoperative day

In Group II the respiration rate showed a marked increase at 24 hours postoperatively and persisted during the postoperative period

(iii) Haemogram (Tables 8 and 9)

a Hemoglobin content (g/dl)

In Group I the haemoglobin content was 14 36 ± 0 56 at 0 minutes 15 31 ± 0 53 at 24 hours postoperatively 15 58 ± 0 62 on the 3rd day 14 30 ± 0 51 on the 5th day 14 00 ± 0 80 on the 7th day and 15 18 ± 0 71 on the 15th day

In Group II the hemoglobin content was 16 43 ± 1 06 at 0 minutes 16 16 ± 1 08 at 24 hours postoperatively 15 73 ± 0 69 on the 3rd day 15 20 ± 0 63 on the 5th day 14 70 + 0 99 on the 7th day and 13 10 ± 0 35 on the 15th day

The hemoglobin content did not show marked variations on different postoperative days in both the groups

b Packed cell volume (per cent)

In Group I the packed cell volume was 40 83 ± 1 84 at 0 minutes 43 00 ± 2 21 at 24 hours 40 83 ± 2 55 on the 3rd day 39 83 ± 2 71 on the 5th day 36 83 ± 2 15 on the 7th day and 38 16 ± 2 48 on the 15th day

In Group II the packed cell volume was 42 83 ± 2 13 at 0 minutes 40 66 ± 2 06 at 24 hours 39 66 ± 2 62 on the 3rd day 38 66 + 2 36 on the 5th day 39 83 ± 2 44 on the 7th day and 40 00 ± 5 65 on the 15th day

The packed cell volume did not show marked variations on different postoperative days in both the groups

c Total erythrocyte count (x 10^6/cu mm)

In Group I the total erythrocyte count was 7 41 ± 0 47 at 0 minutes 7 82 ± 0 56 at 24 hours 7 13 ± 0 64 on the 3rd day 7 52 ± 0 19 on the 5th day 7 13 ± 0 47 on the 7th day and 8 07 ± 0 68 on the 15th dav

In Group II the total erythrocyte count was 7 82 ± 0 29 at 0 minutes 8 34 ± 0 56 at 24 hours 7 72 ± 0 35 on the 3rd day 7 70 ± 0 43 on the 5th day 7 73 + 0 53 on the 7th day and 7 86 ± 1 03 on the 15th day

The total erythrocyte count did not show marked variations on different postoperative days in both the groups

d Total leucocyte count (x 10^3/cu mm)

In Group I the total leucocyte count was 14 12 + 2 57 at 0 minutes 27 06 ± 2 43 at 24 hours 19 98 ± 3 13 on the 3rd day 19 20 ± 3 40 on the 5th day 14 68 ± 1 01 on the 7th day and 12 07 ± 0 59 on the 15th day

In Group II the total leucocyte count was 19 93 ± 1 22 at 0 minutes 29 10 ± 1 82 at 24 hours 25 21 ± 2 23 on the 3rd day 23 48 ± 3 65 on the 5th day 17 43 ± 3 40 on the 7th day and 13 45 ± 0 74 on the 15th day

In both the groups the increase in total leucocyte count seen at 24 hours postoperatively persisted upto the 5th postoperative day and was near normal value on the 7th postoperative day

e Neutrophil count (per cent)

In Group I the neutrophil count was 78 50 ± 1 59 at 0 minutes 74 66 ± 1 09 at 24 hours 78 50 ± 0 90 on the 3rd day 73 83 ± 1 62 on the 5th day 74 16 ± 1 65 on the 7th day and 76 50 ± 0 87 on the 15th day

In Group II the neutrophil count was 72 66 ± 1 74 at 0 minutes 72 50 ± 1 30 at 24 hours 69 83 ± 1 67 on the 3rd day

74 83 ± 0 72 on the 5th day 71 16 ± 1 77 on the 7th day and 72 00 ± 0 00 on the 15th day

The neutrophil count did not show marked variations on different postoperative days in both the groups

f Lymphocyte count (per cent)

In Group I the lymphocyte count was 17 66 ± 1 95 at 0 minutes 20 16 ± 0 96 at 24 hours 17 16 ± 0 76 on the 3rd day 21 16 ± 1 06 on the 5th day 21 66 ± 1 21 on the 7th day and 18 50 ± 0 84 on the 15th day

In Group II the lymphocyte count was 23 66 ± 1 85 at 0 minutes 20 33 ± 1 57 at 24 hours 21 50 ± 1 17 on the 3rd day 19 16 ± 0 54 on the 5th day 23 16 ± 1 83 on the 7th day and 24 50 ± 0 35 on the 15th day

In both the groups the lymphocyte count did not show marked variations on different postoperative days

g Monocyte count (per cent)

In Group I the monocyte count was 1 66 + 0 19 at 0 minutes 2 16 ± 0 36 at 24 hours 2 00 ± 0 40 on the 3rd day 2 40 ± 0 35 on the 5th day 1 40 ± 0 21 on the 7th day and 2 16 ± 0 28 on the 15th day

In Group II the monocyte count was 2 00 + 0 33 at 0 minutes 3 33 ± 0 60 at 24 hours 4 50 + 0 56 on the 3rd day 2 83 ± 0 43 on the 5th day 2 83 ± 0 43 on the 7th day and 1 00 ± 0 00 on the 15th day

In Group I the monocyte count did not show marked variations on different postoperative days

In Group II increase in monocyte count seen at 24 hours postoperatively persisted upto the 3rd postoperative day and was near normal value on the 5th postoperative day

h Eosinophil count (per cent)

In Group I the eosinophil count was 2 16 ± 0 43 at 0 minutes 3 00 ± 0 33 at 24 hours 2 33 ± 0 38 on the 3rd day 3 00 ± 0 52 on the 5th day 2 50 ± 0 61 on the 7th day and 2 83 ± 0 28 on the 15th day

In Group II the eosinophil count was 1 66 ± 0 30 at 0 minutes 3 83 ± 0 28 at 24 hours 4 16 ± 0 68 on the 3rd day 3 16 ± 0 59 on the 5th day 2 83 ± 0 28 on the 7th day and 2 50 ± 0 35 on the 15th day

In Group I the eosinophil count did not show marked variations on different postoperative days

Table 8 Haemogram before surgery and on different postoperative days in dogs (Group I)

Parameters and units	Intervals					
	0 min	24 h	3rd day	5th day	7th day	15th day
Hemoglobin content (g/dl)	14 36± 0 56	15 31± 0 53	15 58± 0 62	14 30± 0 51	14 00+ 0 80	15 18+ 0 71
Packed cell volume (%)	40 83± 1 84	43 00± 2 21	40 83± 2 55	39 83± 2 71	36 83± 2 15	38 16+ 2 48
Total erythrocyte count (10^6/cu mm)	7 41+ 0 47	7 82± 0 56	7 13± 0 64	7 52± 0 19	7 13+ 0 47	8 07± 0 68
Total leucocyte count (10 /cu mm)	14 12± 2 57	27 06± 2 43	19 98± 3 13	19 20± 3 40	14 68± 1 01	12 07± 0 59
Neutrophil count (%)	78 50+ 1 59	74 66+ 1 09	78 50± 0 90	73 83+ 1 62	74 16± 1 65	76 50+ 0 87
Lymphocyte count (%)	17 66± 1 95	20 16± 0 96	17 16± 0 76	21 16± 1 06	21 66+ 1 21	18 50± 0 84
Monocyte count (%)	1 66± 0 19	2 16± 0 36	2 00± 0 40	2 40± 0 35	1 40± 0 21	2 16± 0 28
Eosinophil count (%)	2 16± 0 43	3 00± 0 33	2 33+ 0 38	3 00± 0 52	2 50+ 0 61	2 83± 0 28
Basophil count (%)	0 00	0 00	0 00	0 00	0 00	0 00

Table 9 Haemogram before surgery and on different postoperative days in dogs (Group II)

Parameters and units	Intervals					
	0 min	24 h	3rd day	5th day	7th day	15th day
Hemoglobin content (g/dl)	16 43± 1 06	16 16± 1 08	15 73± 0 69	15 20± 0 63	14 70± 0 99	13 10± 0 35
Packed cell volume (%)	42 83± 2 13	40 66± 2 06	39 66± 2 62	38 66± 2 36	39 83± 2 44	40 00± 5 65
Total erythrocyte count (10^6/cu mm)	7 82± 0 29	8 34± 0 56	7 72± 0 35	7 70± 0 43	7 73± 0 53	7 86± 1 03
Total leucocyte count (10^3/cu mm)	19 93± 1 22	29 10± 1 82	25 21± 2 23	23 48± 3 65	17 43± 3 40	13 45± 0 74
Neutrophil count (%)	72 66± 1 74	72 50± 1 30	69 83± 1 67	74 83± 0 72	71 16± 1 77	72 00± 0 00
Lymphocyte count (%)	23 66± 1 85	20 33± 1 57	21 50± 1 17	19 16± 0 54	23 16± 1 83	24 50± 0 35
Monocyte count (%)	2 00± 0 33	3 33± 0 60	4 50± 0 56	2 83± 0 43	2 83± 0 43	1 00± 0 00
Eosinophil count (%)	1 66± 0 30	3 83± 0 28	4 16± 0 68	3 16± 0 59	2 83± 0 28	2 50± 0 35
Basophil count (%)	0 00	0 00	0 00	0 00	0 00	0 00

In Group II increase in the eosinophil count seen at 24 hours postoperatively persisted upto the 5th postoperative day and was near normal value on the 7th postoperative day

(iv) Radiographic evaluation

Group I

3rd postoperative day There was no reduction in the size of tracheal lumen at the site of anastomosis in this group of dogs except in one dog (A6) The contrast medium was seen adhered to the anastomosed edges of the trachea in two dogs (A1 and A2) In four dogs (A1 A2 A4 and A6) slight edema was observed adjacent to the anastomotic site

7th postoperative day There was no reduction in the size of the tracheal lumen at the anastomotic site in the animals except in one dog (A6) The contrast medium was seen adhered to the anastomosed edges of the trachea in one dog (A1) Oedematous changes at the site of anastomosis was observed in one dog (A2)

15th postoperative day There was no reduction in the size of the tracheal lumen at the site of anastomosis in the animals except in one dog (A6) Fig 5

30th postoperative day There was no reduction in the size of the tracheal lumen at the anastomotic site (dogs A1 A2 A3 and A4) (Fig 6)

45th postoperative day There was no reduction in the size of the tracheal lumen at the anastomotic site (dogs A1 and A2) (Fig 7)

Group II

3rd postoperative day There was no reduction in the size of the tracheal lumen at the site of reconstruction in the animals except in one dog (B2) Edema in the vicinity of the site of reconstruction was seen in three dogs (B2 B3 and B6)

7th postoperative day Reduction in the size of the tracheal lumen at the site of reconstruction was seen in four dogs (B1 B2 B3 and B4) whereas no reduction was observed in two dogs (B5 and B6)

15th postoperative day Severe constriction was seen at the site of tracheal reconstruction in dog B2 whereas no reduction in the size of the tracheal lumen was observed in dogs B6 (Fig 8)

30th postoperative day There was no reduction in the size of the tracheal lumen at the site of reconstruction (dog B6) (Fig 9)

Fig.5. Contrast radiograph (lateral) of the trachea on the 15th postoperative day in Group I, showing slight reduction in the size of the tracheal lumen at the anastomotic site

Fig.6. Contrast radiograph (lateral) of the trachea on the 30th postoperative day in Group I, showing no reduction in the size of the tracheal lumen at the anastomotic site

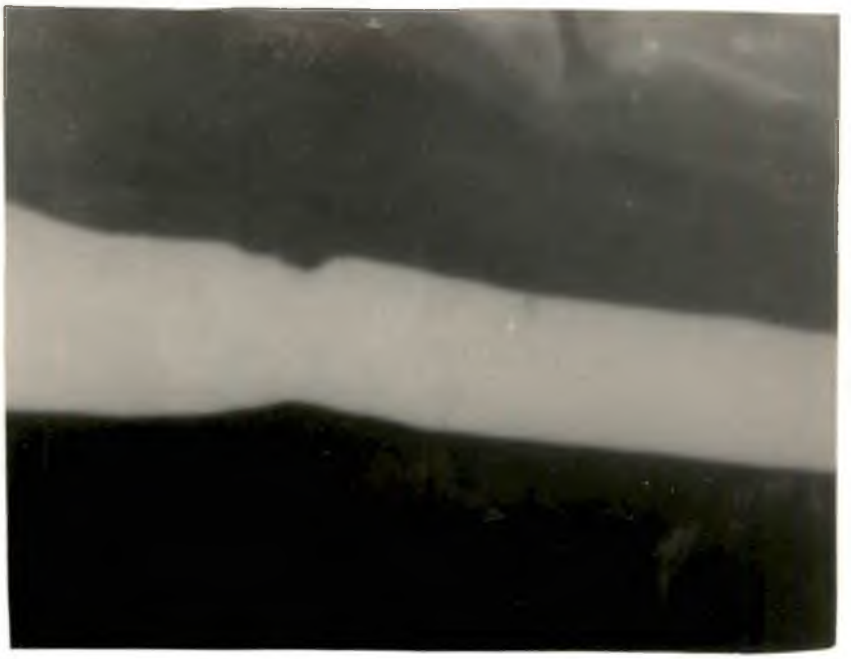


Fig.8. Contrast radiograph of the trachea on the 15th postoperative day (dog B2) in Group II, showing severe constriction of the tracheal lumen at the site of reconstruction

Fig.9. Lateral radiograph of the trachea on the 30th postoperative day in Group II, showing no reduction in the size of the tracheal lumen at the site of reconstruction

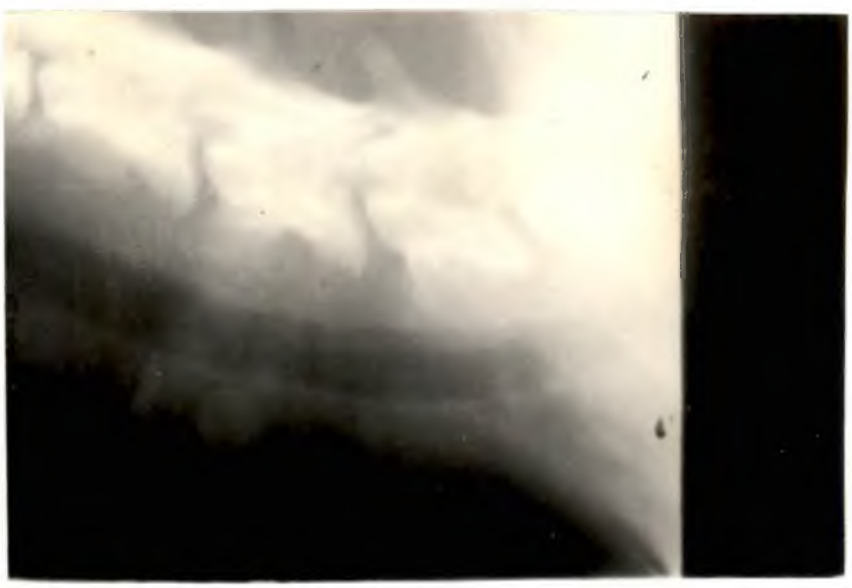


Fig.7. Contrast radiograph (lateral) of the trachea on the 45th postoperative day in Group I, showing no reduction in the size of the tracheal lumen at the anastomotic site

45th postoperative day Slight reduction in the size of the tracheal lumen at the site of reconstruction was seen (dog B6)

(v) Autopsy findings

Group I

Dogs A5 and A6 At autopsy on the 15th postoperative day gross examination of the trachea at the site of anastomosis revealed adhesions between the anastomotic site and adjacent structures in dog A5 (Fig 10 and 11) but no adhesions were seen in dog A6 Vascularization at the site of anastomosis and slight reduction in the size of the tracheal lumen at the anastomotic site was seen in dog A6

Dogs A3 and A4 At autopsy on the 30th postoperative day gross examination of the trachea at the site of anastomosis showed moderate adhesions between the anastomotic site and adjacent tissue in both dogs (Fig 12) Vascularization was seen at the site of anastomosis Suture granulomas were observed at the anastomotic site externally and within the tracheal lumen in both the dogs (Fig 13)

Dogs A1 and A2 At autopsy on the 45th postoperative day gross examination of the trachea at the site of anastomosis demonstrated mild adhesions between the anastomotic site and the adjacent structures in dog A1 but no adhesions were seen in dog A2 Vascularization of the ventral surface of the trachea

adjacent to the anastomotic site was seen in dog A2 (Fig 14) Suture granulomas externally and within the tracheal lumen were observed at the anastomotic site in both the dogs (Fig 15)

Group II

Dogs B1 B2 B3 and B4 At autopsy on the 13th (B4) 14th (B1 and B3) and 22nd (B2) day postoperatively gross examination of the trachea at the site of reconstruction demonstrated dense adhesions between the mesh and surrounding tissue The tracheoprosthetic junction was intact and the mesh was circumferentially covered by a glistening membrane (Fig 16) The mesh was uniformly infiltrated with tissue The prosthesis was well bonded to the tracheal wall and it was difficult to delineate the prosthesis from the surrounding tissue There was almost complete occlusior of the tracheal lumen at the site of reconstruction due to ingrowth of tissue into the lumen (Fig 17)

In dog B1 adhesion between the esophagus and mesh was extensive Ulceration was also seen on the wall of the esophagus in contact with the mesh

Dog B5 At autopsy on the 9th postoperative day gross examination of the trachea revealed anastomotic dehiscence at both the proximal and distal segments on the ventral aspect of the trachea The animal had extensive subcutaneous emphysema The mesh was irregularly infiltrated by tissue at the areas of

Fig.10. Trachea *in situ* at autopsy on the 15th postoperative day in Group I, showing adhesions between the anastomotic site and muscles

Fig.11. Gross specimen of the trachea at autopsy on the 15th postoperative day in Group I, showing the site of anastomosis

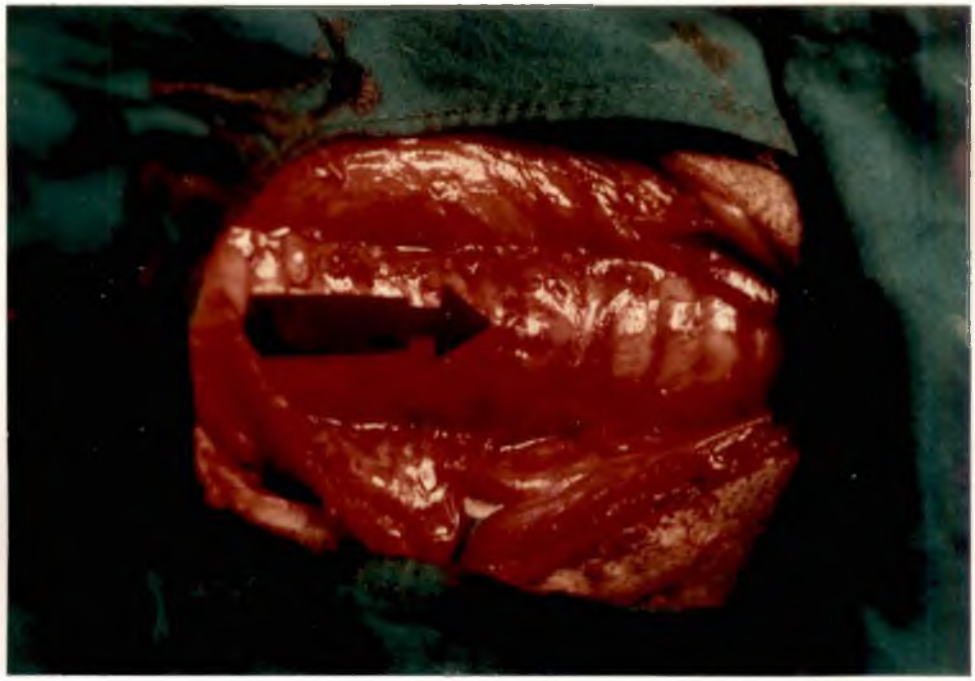
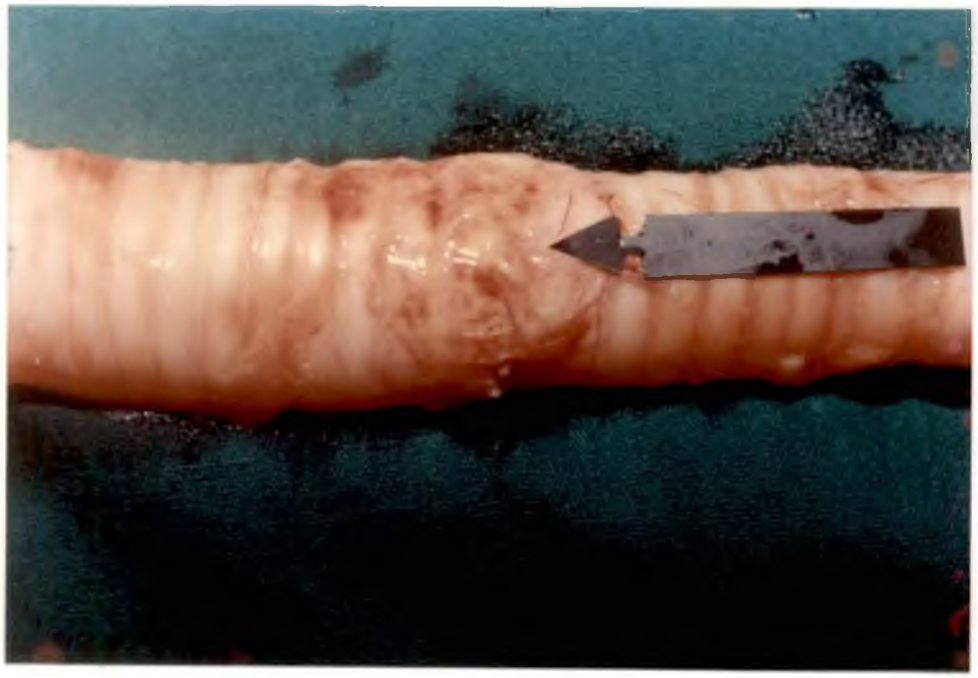


Fig.12. Trachea *in situ* at autopsy on the 30th postoperative day in Group I, showing adhesions between the anastomotic site and muscles

Fig.13. Gross specimen of the trachea at autopsy on the 30th postoperative day in Group I, showing suture line granuloma formation at the anastomotic site



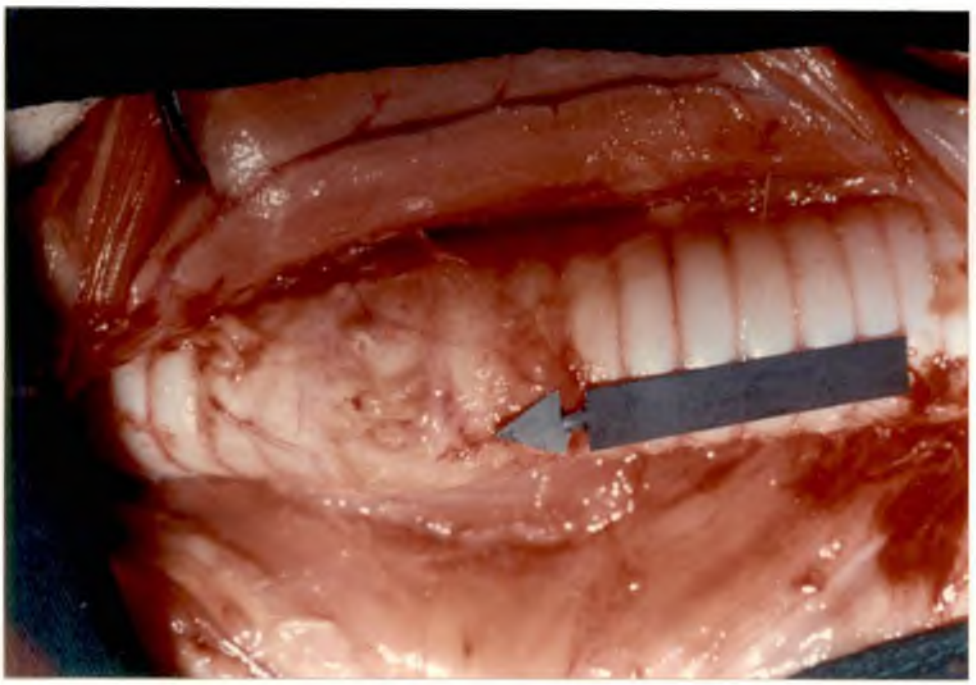


Fig.14. Trachea *in situ* at autopsy on the 45th postoperative day in Group I, showing newly developed vessels at the site of anastomosis

Fig.15. Gross specimen of the trachea at autopsy on the 45th postoperative day in Group I, showing formation of suture line granuloma at the anastomotic site

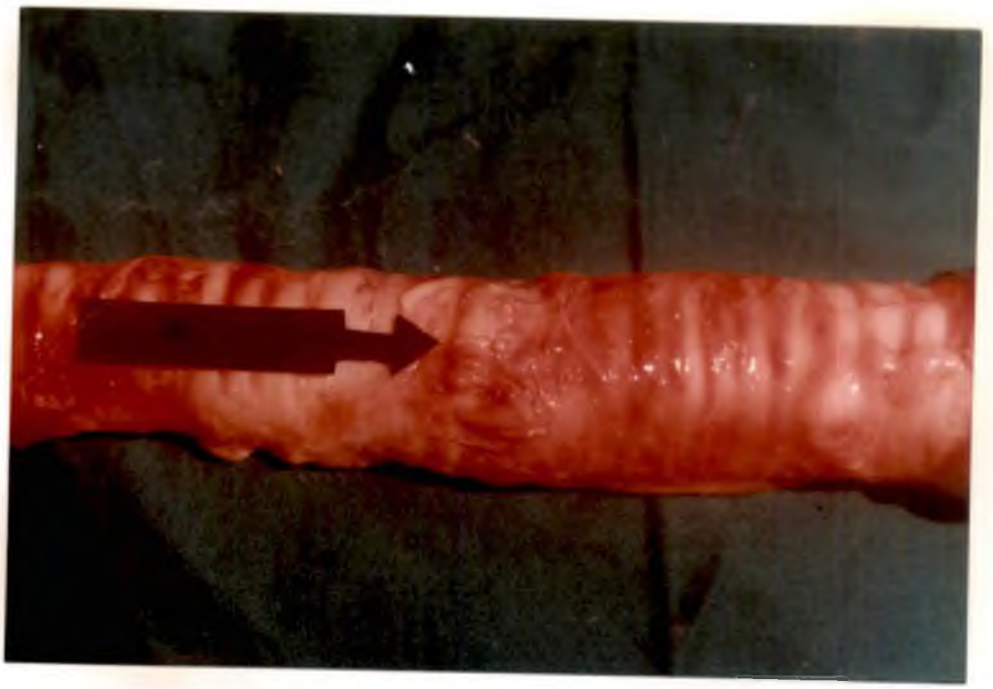


Fig.16. Gross specimen of the trachea at autopsy on the 22nd postoperative day in Group II, showing glistening membrane covering the prosthesis at the site of reconstruction

Fig.17. Gross specimens of the trachea at autopsy on the 22nd postoperative day in Group II, showing occlusion of the tracheal lumen at the site of reconstruction, and normal tracheal segment distal to the site of reconstruction

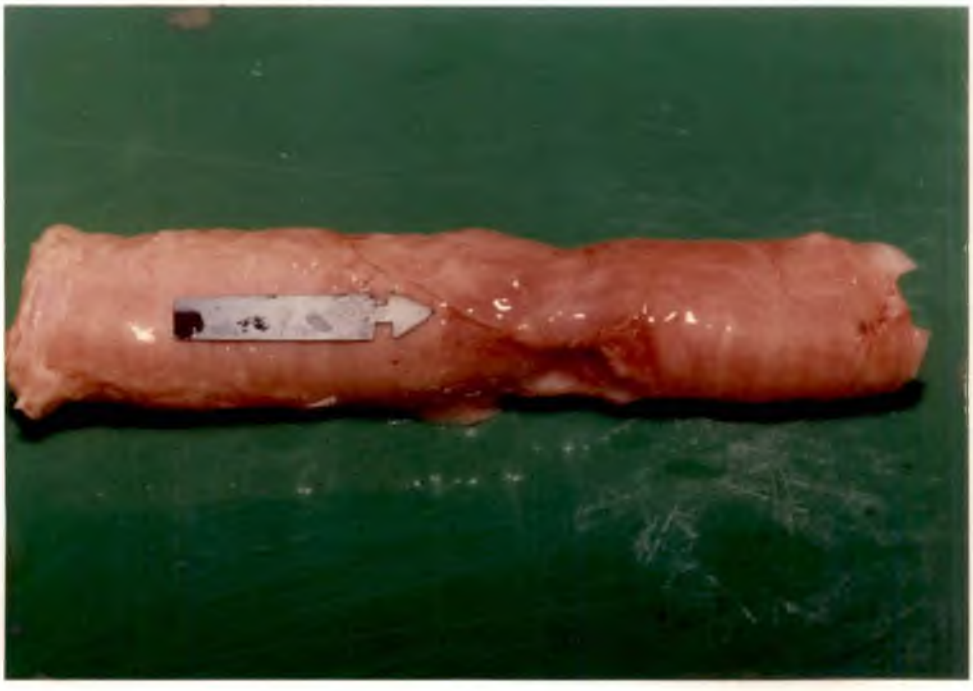
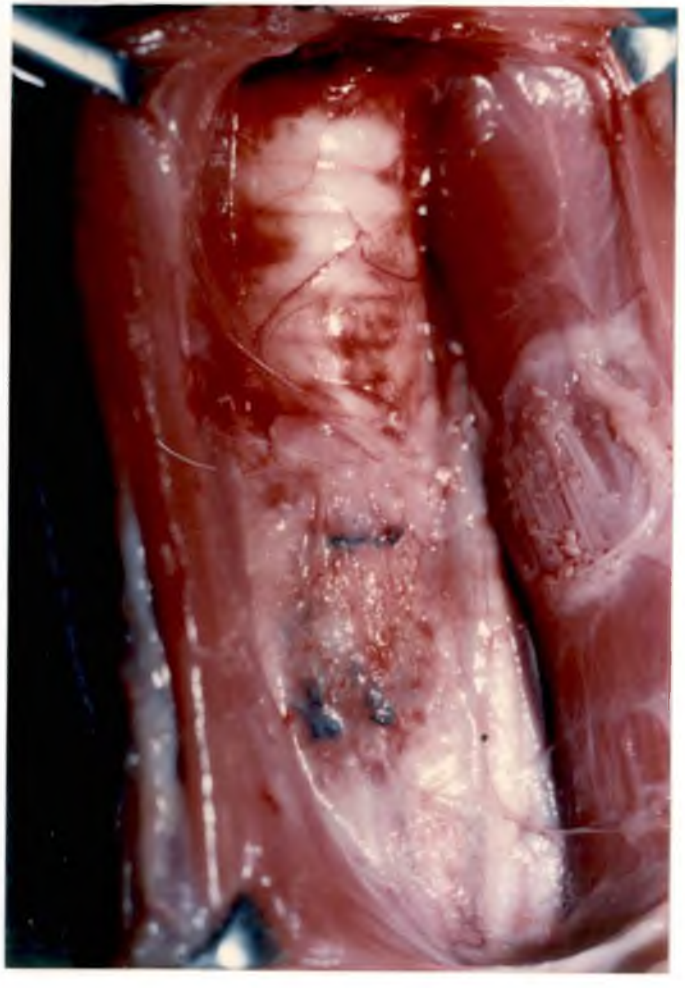


Fig.18. Gross specimen of the trachea at autopsy on the 45th postoperative day in Group II, showing dense adhesions

Fig.19. Trachea *in situ* at autopsy on the 45th postoperative day in Group II, showing dense adhesions between the site of reconstruction and muscle and newly formed vessels at the site of reconstruction



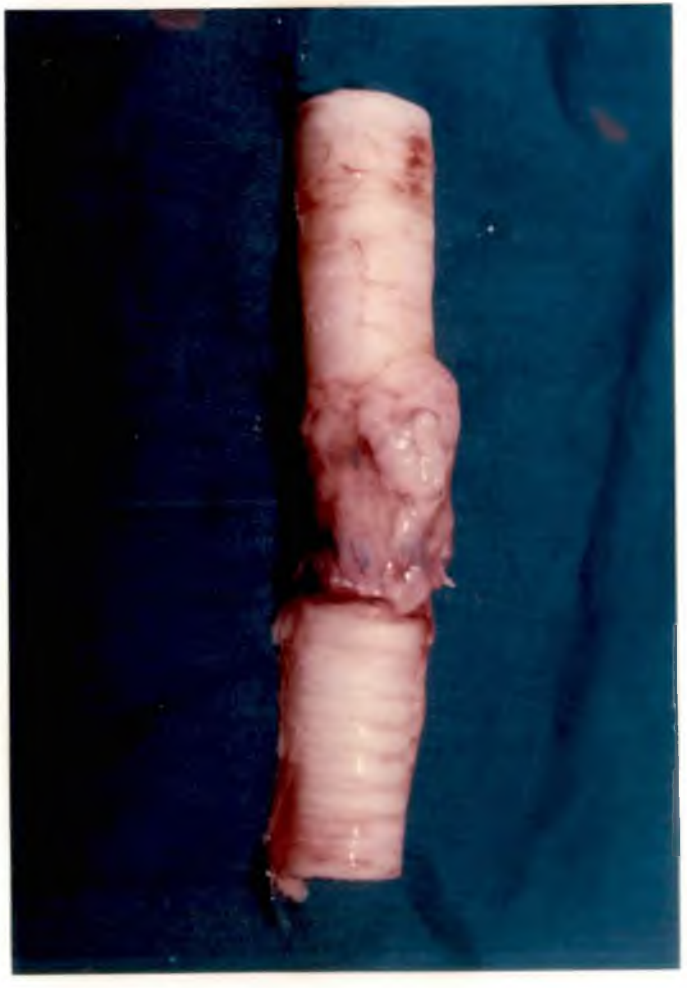
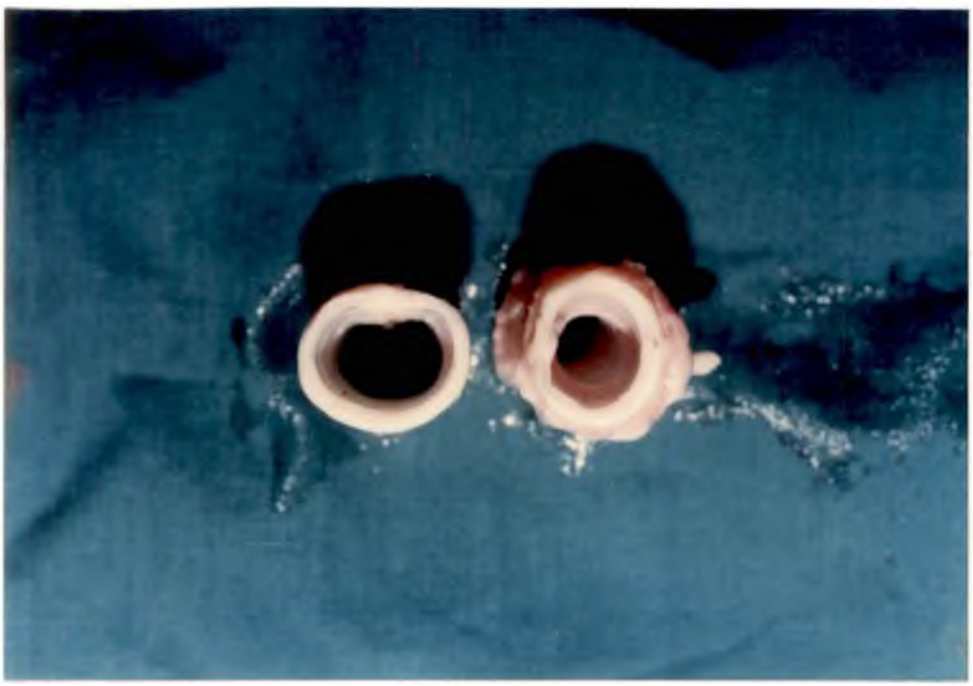


Fig.20. Gross specimens of the trachea at autopsy on the 45th postoperative day in Group II, showing slight reduction in the size of the tracheal lumen at the site of reconstruction and normal tracheal segment distal to the site of reconstruction



attachment to the trachea There was no stenosis of the tracheal lumen at the site of reconstruction

Dog B6 At autopsy on the 45th postoperative day gross examination of the trachea at the site of reconstruction revealed dense adhesions between the prosthesis and the adjacent tissue (Fig 18) The tracheoprosthetic junction was intact and vascularization was seen at the site (Fig 19) The mesh was completely covered by connective tissue The prosthesis was firmly bonded to the tracheal wall and fully incorporated at the site of reconstruction The mesh could not be easily delineated from the surrounding tissue There was only slight reduction in the size of the tracheal lumen at the site of reconstruction (Fig 20)

(vi) Histopathology

Group I

Evaluation of the anastomosis on the 15th postoperative day revealed a continuous squamous type mucosal epithelium at the line of anastomosis There was marked proliferation of angioblasts and fibroblasts in the mucosal as well as submucosal layers Perichondrial proliferation and formation of small islets of cartilage were evident (Fig 21) Diffuse infiltration with neutrophils and mononuclear cells was observed in the submucosa Submucosal edema and congestion of vessels was observed

Mononuclear and polymorph infiltration could be seen around the suture material The sub mucosal glands at the vicinity of the suture material showed proliferation of goblet cells and there was periglandular infiltration with moderate number of mononuclears

Complete regeneration of the tracheal epithelium was seen on the 30th postoperative day The epithelium was pseudostratified columnar ciliated with many goblet cells The submucosal glands appeared active (Fig 22) Submucosal fibroblasts appeared more mature and there was greater deposition of collagen at the site of anastomosis Perichondrial proliferation was observed from the ends of either cartilage at the anastomotic site Capillary network was well developed and there was less cellular infiltration in the submucosa

Normal tracheal epithelium lined the mucosa at the line of anastomosis on the 45th postoperative day Submucosal glands appeared active with predominant goblet cell activity Perichondrial proliferation from the ends of either cartilage at the anastomotic site was evident There was no inflammatory cellular infiltration in any of the ayers of the trachea at the site of anastomosis

Group II

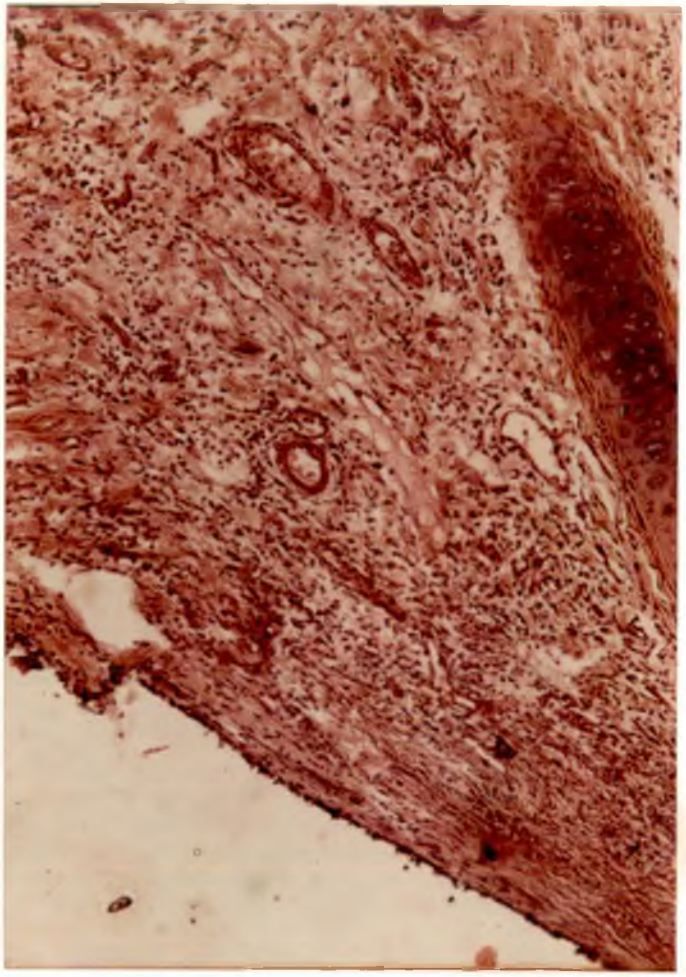
Tracheal stenosis in four dogs (B1 B2 B3 and B4) was associated with ingrowth of granulation tissue The granulation contained predominantly proliferating fibroblasts and angioblasts (Fig 23) Macrophages could also be observed in the granulation Perichondrial fibrosis was extensive Signs of congestion hemorrhage fibrinous deposits and edema were seen at the graft site An inflammatory reaction with neutrophils was also observed Invasion of the prosthesis by fibrous tissue and proliferating fibroblasts was evident (Fig 24)

In dog B5 there was extensive congestion and hemorrhage in the submucosa Angioblastic and fibroblastic proliferation was observed The mesh was invaded by fibrous tissue only at the site of partial attachment to the dorsal membrane of the trachea

Histopathological examination in dog B6 revealed continuity of the epithelium over the graft and a well developed submucosa (Fig 25) The graft site was seen occupied by collagen and elastic fibres along with a few fibroblasts The mesh was uniformly invaded by the proliferating fibrocollagenous tissue

Fig.21 Photomicrograph of the trachea at the site of anastomosis on the 15th postoperative day in Group I showing continuity of epithelium and formation of islets of cartilage (H&E x 250)

Fig.22. Photomicrograph of the trachea at the site of anastomosis on the 30th postoperative day in Group I, showing complete regeneration of the tracheal epithelium and functioning submucosal glands (H&E x 250)



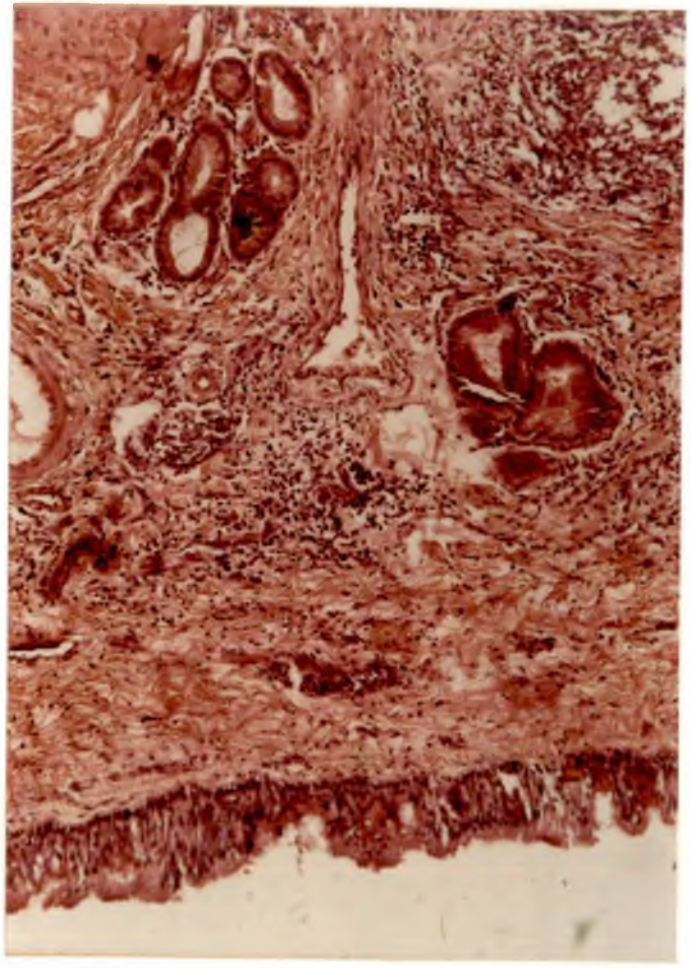
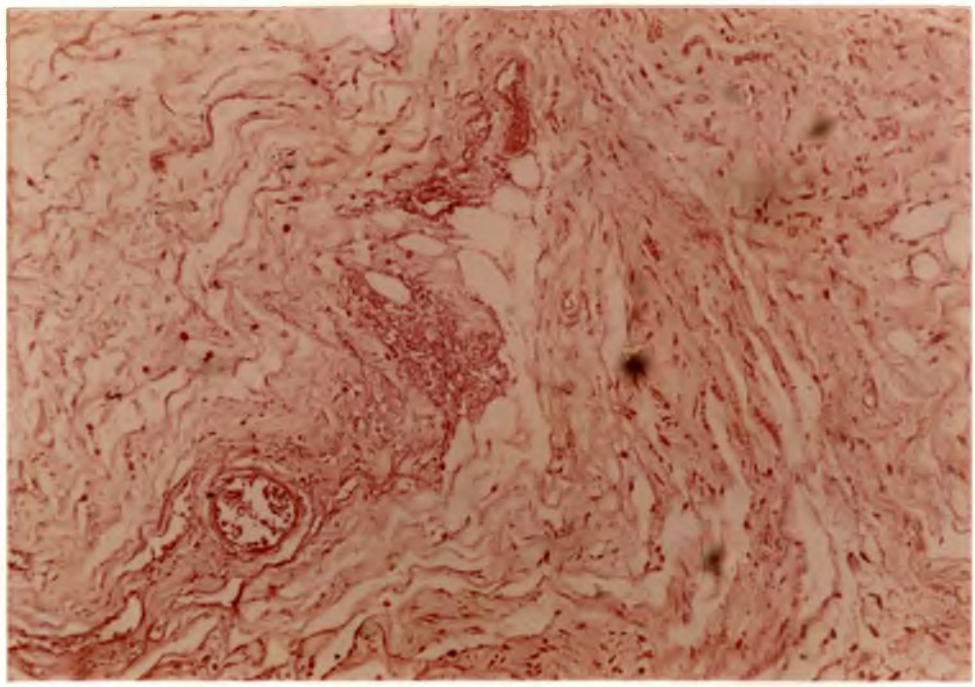


Fig.23. Photomicrograph of the trachea at the site of stenosis on the 14th postoperative day in Group II, showing extensive proliferation of fibroblasts (H&E x 250)

Fig.24. Photomicrograph of the trachea at the site of reconstruction on the 13th postoperative day in Group II, showing invasion of the mesh with fibrous tissue and proliferating fibroblasts (H&E x 250)



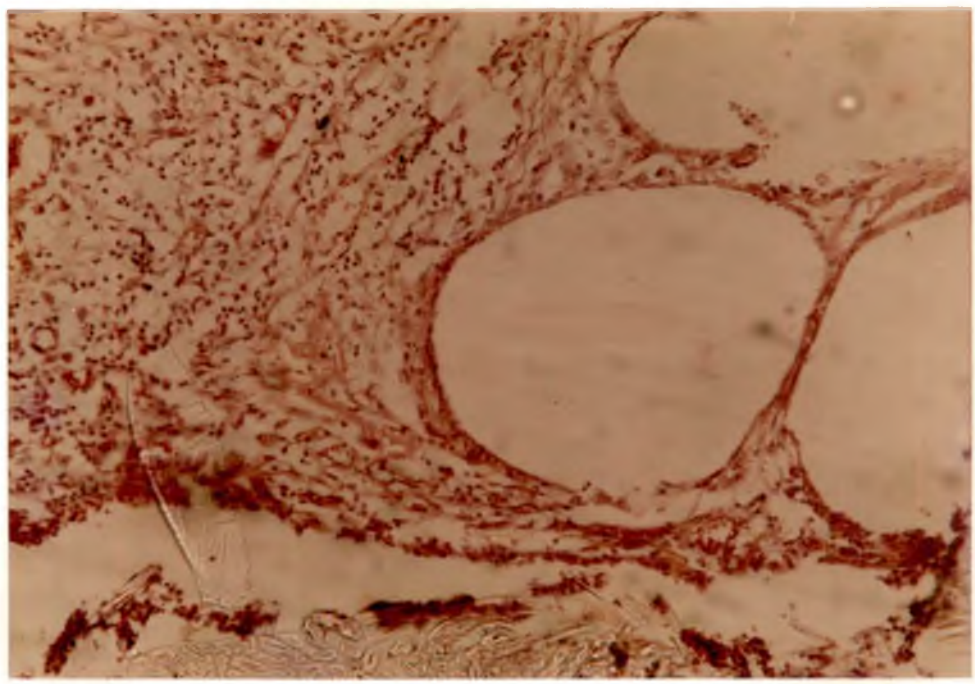
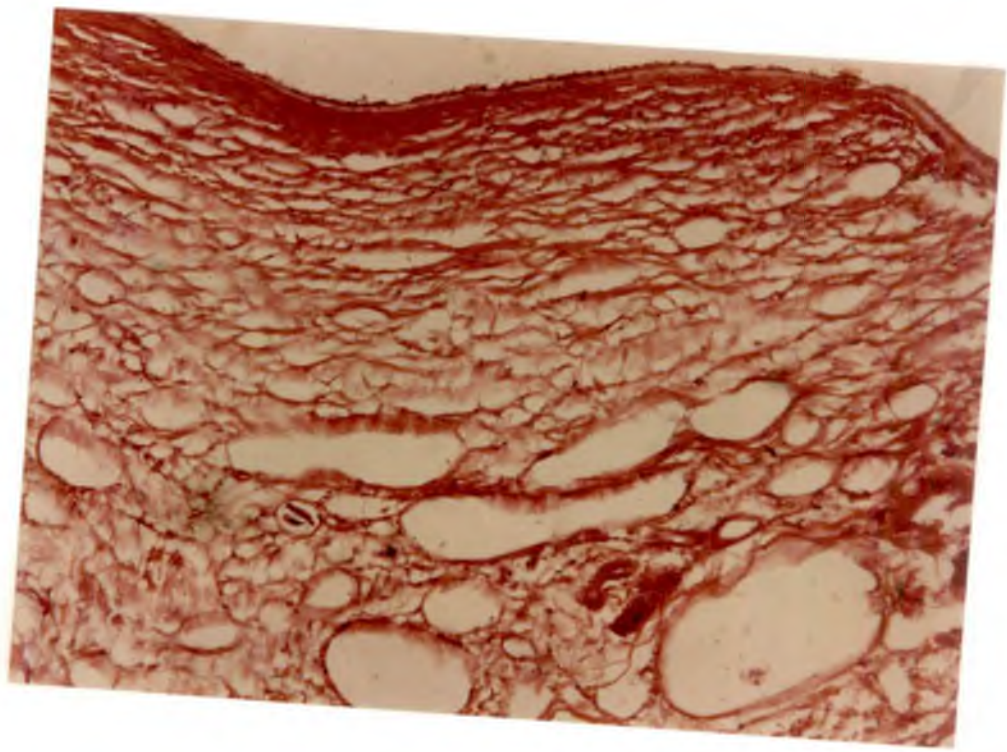


Fig.25. Photomicrograph on the trachea at the site of reconstruction on the 45th postoperative day in Group II, showing continuity of the epithelium and well-developed submucosa (H&E x 250)



Discussion

DISCUSSION

General anaesthesia maintained with inhalant anaesthetics is preferred in surgical procedures of trachea since it facilitates in assisting respiration However when circumferential resection of trachea is needed general anaesthesia with non inhalant technique is chosen for ease of anastomosis In the present study premedication with acepromazine maleate (0 02 mg/kg bodyweight) IM and induction with thiopentone sodium (2 5 per cent solution) IV was adopted The average dose of thiopentone sodium required for surgical anaesthesia was 22 63 mg/kg bodyweight Induction was smooth and anaesthesia was satisfactory for performing resection and reconstruction of the cervical trachea The time taken for induction was 3 26 ± 0 10 minutes and the duration of surgical anaesthesia was 65 00 ± 3 29 minutes The time for recovery was 192 91 ± 13 68 minutes The use of barbiturates for anaesthesia in tracheal reconstruction in dogs has been reported by Atamanyuk and Melrose (1965) Bryan et al (1981) and Varshney and Kumar (1984) In the present study management of respiration during resection and anastomosis could be effectively done under the anaesthetic technique using acepromazine and thiopentone

Decrease in rectal temperature and respiration rate and increase in pulse rate were noticed immediately after the induction of anaesthesia Haematological alterations were

slight reduction in hemoglobin content total leucocyte count and lymphocyte count marked reduction in packed cell volume and total erythrocyte count and a slight increase in neutrophil and eosinophil count These transient variations in the present study did not influence the surgical anaesthesia recovery from anaesthesia or postoperative period Variations in physiological parameters and haemogram under acepromazine thiopentone anaesthesia in dogs have been studied extensively (Usenik and Cronkite 1965 Popovic et al 1972 Turner et al 1974 Lang et al 1979 Rawlings and Kolata 1983 Sharma et al 1983c Farver et al 1986 Robinson et al 1986 and Mansell and Parry 1992)

Circumferential resection of two adjacent tracheal rings of the cervical trachea and reconstruction of the defect by end to end anastomosis was done in animals of Group I in the present study Traction sutures of 3/0 silk were used to approximate the cut ends of the trachea for ease of suturing, effective manipulation, apposition of the cut ends and reduction of tension at the suture line Simple interrupted sutures used for anastomosis proved to be air tight at the site of anastomosis End to end anastomosis after circumferential resection of segment of the trachea and the use of sutures of silk nylon stainless steel wire polypropylene and polyglactin 910 has been reported to be satisfactory in dogs (Cantrell and Folse 1961 Gordon 1973 Lau et al 1980 Bryan et al 1981

Harvey and Skyes 1982 Varshney and Kumar 1984 White and Kellagher 1986 Kellagher and White 1987 and Salisbury et al 1990) The use of 3/0 silk and the techniques in the present study was satisfactory for effecting anastomosis though two tracheal rings were resected and removed

Clinical evaluation during the postoperative period of observation including physiological parameters haemogram and radiographic studies revealed that the animals of this group made an uneventful recovery Slight postoperative edema at the site of skin incision in two dogs (A3 and A5) subsided by the 5th postoperative day and subcutaneous serous exudate at the site of skin incision in one dog (A1) responded to aspiration on the 10th postoperative day Respiratory activity was normal throughout the period of observation in all the animals

The rectal temperature did not show any variation The increase in pulse and respiration rate observed at 24 hours postoperatively reached near normal value on the 5th postoperative day Hemoglobin content packed cell volume total erythrocyte count and differential leucocyte count did not show marked variation during postoperative period However the total leucocyte count showed increase at 24 hours postoperatively persisted upto the 5th postoperative day and reached near normal value by the 7th postoperative day

Lateral radiographs of the cervical trachea on different postoperative days revealed that there was no reduction in the size of the tracheal lumen in all the dogs except dog A6 Reduction in the tracheal luminal diameter in dog (A6) was due to slight overriding of the adjacent tracheal ring at the site of anastomosis but did not cause functional stenosis The contrast medium was seen adhered to the anastomosed edges of the trachea on the 3rd postoperative day in two dogs (A1 and A2) and on the 7th postoperative day in one dog (A1) suggestive of ulcers at the site of anastomosis Presence of oedema was observed at the site of anastomosis on the 3rd postoperative day in four animals (A1 A2 A4 and A6) and on the 7th postoperative day in one dog (A2) The local and systemic changes noticed consequent to resection and end to end anastomosis indicate that the reaction was minimal and transient These observations concur with the findings of Varshney and Kumar (1984) and Kinjavdekar and Chaudhary (1991) who reported that end to end anastomosis caused minimal complications in dogs

At autopsy on different postoperative days gross examination of the trachea at the site of anastomosis demonstrated mild to moderate adhesions between the anastomotic site and adjacent tissue Neovascularization with prominent vessels was observed on all sides at the site of anastomosis probably re establishing the segmental blood supply to the trachea There was no reduction in the luminal diameter of

trachea at the site of anastomosis in the animals except dog A6 which showed slight reduction in lumen due to overriding of the adjacent tracheal rings Suture granulomas were observed at the anastomotic site externally and projecting into the tracheal lumen in all the animals However the adhesions and granulomas did not affect the luminal diameter Kinjavdekar and Chaudhary (1991) recorded absence of both adhesions and suture line granulomas following tracheal anastomosis using silk sutures though Ferguson et al (1950) and Lau et al (1980) recorded granulomas and Maeda and Grillo (1972) Salisbury et al (1990) and Smith et al (1990) reported narrowing and thickening at the site of anastomosis

Microscopic evaluation of the site of anastomosis at different stages revealed progressive healing in different layers of tissue re establishing the anatomical continuity Continuity of the mucosal lining was observed by the 15th postoperative day and complete regeneration of pseudostratified columnar ciliated epithelium on the 30th postoperative day The submucosa showed diffuse infiltration of neutrophils and mononuclear cells on the 15th postoperative day but cellular infiltration became scanty by the 30th postoperative day The anastomotic site on the 45th postoperative day revealed normal tracheal epithelium lining the mucosa and no inflammatory cellular infiltration in any of the tracheal layers at the site of anastomosis Extensive proliferation of the perichondrial

(1977) found horizontal mattress sutures to be ideal for fixing tracheal prostheses

During the postoperative period of observation in this group animals except dog B6 developed severe complications Marked stridor and respiratory distress developed in four of the animals (B1 B2 B3 and B4) as early as the 3rd postoperative day Respiratory distress was progressive and the animals died on the 13th (B4) 14th (B1 and B3) and 22nd (B3) days postoperatively In dog B1 vomition and diarrhoea were observed at 24 hours postoperatively and vomition was seen on different postoperative days until death Leakage of air from the mesh was not observed in any of the animals except in dog B5 The animal B5 was free from any signs of respiratory distress until subcutaneous emphysema developed on the 8th postoperative day and death occurred on 9th postoperative day Only one dog (B6) was free from any signs of respiratory distress throughout the period of observation of 45 days postoperative Postoperative complications like dehiscence and stenosis were reported by Craig et al (1953) Taber and Tomatis (1958) Beall et al (1962) and Beall et al (1963)

The rectal temperature did not show any variation The pulse rate showed marked decrease and the respiration rate showed a marked increase during the period of observation The hemoglobin content packed cell volume total erythrocyte count

neutrophil count and lymphocyte count did not show marked variations during the postoperative period in all the animals The total leucocyte count and eosinophil count showed an increase at 24 hours postoperatively persisted upto 5th postoperative day and reached near normal values by the 7th postoperative day Increase in the monocyte count was seen at 24 hours postoperatively and reached near normal value by the 7th postoperative day Though the postoperative complications produced respiratory tract stenosis the haematological and physiological parameters except the pulse and respiration rate did not show marked variations indicating that the postoperative complications had little systemic effects

Lateral radiographs of the cervical trachea on the 3rd postoperative day showed that there was no reduction in the size of the trachea lumen at the site of reconstruction in all the dogs except dog B6 Radiography on the 7th postoperative day revealed reduction in the size of the tracheal lumen at the site of reconstruction in dogs B1 B2 B3 and B4 whereas no reduction was observed in dog P5 and B6 Radiographs on the 15th postoperative day showed severe reduction in the size of the tracheal lumen at the site of reconstruction in dog B2 but no reduction was observed in dog B6 There was no reduction in the size of the tracheal lumen at the site of reconstruction on the 30th postoperative day in dog B6 but slight reduction was

observed on the 45th postoperative day The changes observed in radiography corroborated with the clinical observations

At autopsy gross examination of the trachea at the site of reconstruction revealed dense adhesions between the mesh and surrounding tissue Adhesion between the oesophagus and mesh was extensive in dog B1 ard ulceration was seen on the wall of the oesophagus which was in contact with the mesh as observed by Taber and Tomatis (1958) in dogs The tracheoprosthetic junction was intact in all the animals except dog B5 The mesh was firmly bonded to the tracheal wall and the prosthesis could not be differentiated from the surrounding tissue except in dog B5 in which anastomotic dehiscence was observed both at the proximal and distal tracheal segments on the ventral aspect of the trachea The mesh was completely infiltrated by tissue in all animals except dog B5 in which the mesh was irregularly infiltrated by tissue at the areas of attachment to the trachea Bright (1981) reported uniform tissue infiltration into Marlex mesh and better bondage of this material to surrounding tissue when used to replace defects in body wall of dogs

In the present experiment the mesh was seen covered circumferentially by a glistening membrane externally in four animals (B1 B2 B3 and B4) and the tracheal lumen at the site of reconstruction was almost completely occluded by ingrowth of tissue In dog B6 the mesh was completely covered by connective

tissue externally and vascularization was observed at the site of reconstruction with slight reduction in the tracheal lumen at the site of reconstruction

Histopathological examination revealed that tracheal stenosis noticed in four of the dogs was associated with ingrowth of granulation tissue which showed predominance of proliferating fibroblasts and angioblasts Perichondrial fibrosis was extensive The prosthesis was infiltrated by fibrous tissue in all the animals except dog B5 in which anastomotic dehiscence occurred Microscopic evaluation of the site of reconstruction on the 45th postoperative day in dog B6 revealed continuity of epithelium over the graft and the graft site was seen occupied by collagen and elastic fibres along with a few fibroblasts Beall et al (1962) opined that overgrowth of granulation tissue could be due to delay in epithelialization from the cut ends of the trachea to the prosthesis due to persistence of an acute inflammatory reaction and once epithelialization occurred there was no further tendency towards stenosis

Reconstruction of the trachea with Marlex mesh was easy to perform and the prosthesis was fully incorporated at the site of reconstruction in all the animals except one (B5) But the incidence of postoperative complications was high when Marlex mesh prosthesis was used Four of the animals developed tracheal

stenosis associated with overgrowth of granulation tissue into the lumen and one animal had anastomotic dehiscence Only one animal was normal throughout the period of observation where cortisone therapy was continued upto the 10th postoperative day which probably prevented tracheal stenosis due to overgrowth of granulation tissue Sato et al (1957) observed that use of cortisone limited the formation of abnormal fibroplasia following tracheal reconstruction with a prosthesis

Beall et al (1962) recorded that regular bronchoscopic examination and cauterization of excessive granulation until complete epithelialization might prevent occlusion of the tracheal lumen due to overgrowth of granulation tissue However this was not attempted in the present experiment

Summary

SUMMARY

The experiment was conducted on twelve apparently healthy adult nondescript dogs of either sex divided into two groups viz Group I and Group II each consisting of six animals

Circumferential resection of two adjacent tracheal rings of the cervical trachea was performed and the trachea was reconstructed by end to end anastomosis in the animals of Group I and with Marlex mesh prosthesis in the animals of Group II

All the animals were premedicated with acepromazine maleate IM and anaesthesia was induced by 2 5 per cent solution of thiopentone sodium IV Induction of anaesthesia was complete by 3 26 ± 0 10 minutes duration of surgical anaesthesia was 65 00 ± 3 29 minutes and time for recovery was 192 91 ± 13 68 minutes Variation in the physiological and haematological parameters during anaesthesia were not significant

In Group I all the animals had normal respiratory function throughout the period of observation following surgery In Group II all the animals except one developed severe complications and died within one to four weeks postoperatively Only one dog survived in this group and was sacrificed on the 45th postoperative day

During the postoperative period the rectal temperature did not show marked variations in both the groups The pulse and respiration rates showed an initial increase in Group I However in Group II marked decrease in pulse rate and increase in respiration rate was noticed

Hemogram on the different postoperative days showed an increase in the total leucocyte count in both the groups and increase in monocyte and eosinophil count in Group II

Radiography on different postoperative days in Group I demonstrated that there was no reduction in the size of the tracheal lumen at the site of anastomosis in five of the six animals

In Group II radiography revealed a progressive reduction in the size of the tracheal lumen at the site of reconstruction in four animals and only slight reduction in one dog on the 45th postoperative day

At autopsy gross examination of the trachea at the site of anastomosis in Group I showed mild to moderate adhesions to the adjacent tissue and there was no reduction in the size of the tracheal lumen in five of the six dogs of this group

In animals of Group II dense adhesion between the site of reconstruction and adjacent tissue was observed The mesh was

fully incorporated at the site of reconstruction in five of the six animals One animal had shown anastomotic dehiscence Almost complete occlusion of the trachea by overgrowth of tissue was observed in four animals and slight reduction in the tracheal lumen in one animal

Histopathology at the site of anastomosis in Group I revealed complete healing of all the layers of the trachea by the 30th postoperative day

In Group II tracheal stenosis was associated with ingrowth of granulation tissue in four animals The mesh was infiltrated by fibrous tissue in five of the six animals Epithelium was seen lining the prosthesis on the 45th postoperative day

Based on the findings in this study the following conclusions were drawn

1 Anaesthesia using acepromazine thiopentone sodium was satisfactory for reconstructive surgery of the trachea in dogs

2 Circumferential tracheal resection and end to end anastomosis is associated with minimal postoperative complications and complete healing occurs within 30 days

3 The incidence of postoperative complications is high with the use of Marlex mesh prosthesis though the prosthesis is completely incorporated by proliferation ofgranulation tissue at the site of anastomosis

However keeping in view the favourable response obtained in one dog long term evaluation of the Marlex mesh prosthesis with postoperative cortisone therapy needs further study

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TRACHEAL RECONSTRUCTION IN DOGS UNDER ACEPROMAZINE - THIOPENTAL ANAESTHESIA

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ABSTRACT OF A THESIS

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ABSTRACT

The experiment was conducted on twelve apparently healthy adult nondescript dogs of either sex divided into two groups viz Group I and Group II each consisting of six animals

Circumferential resection of two adjacent tracheal rings of the cervical trachea was performed and the trachea was reconstructed by end to end anastomosis in the animals of Group I and with Marlex mesh prosthesis in the animals of Group II

All the animals were premedicated with acepromazine maleate IM and anaesthesia was induced by 2 5 per cent solution of thiopentone sodium IV Induction of anaesthesia was complete by 3 26 + 0 10 minutes duration of surgical anaesthesia was 65 00 ± 3 29 minutes and time for recovery was 192 91 ± 13 68 minutes Variation in the physiological and haematological parameters during anaesthesia were not significant

In Group I all the animals had normal respiratory function throughout the period of observation following surgery In Group II all the animals except one developed severe complications and died within one to four weeks postoperatively Only one dog survived in this group and was sacrificed on the 45th postoperative day

During the postoperative period the rectal temperature did not show marked variations in both the groups The pulse and respiration rates showed an initial increase in Group I However in Group II marked decrease in pulse rate and increase in respiration rate was noticed

Hemogram on the different postoperative days showed an increase in the total leucocyte count in both the groups and increase in monocyte and eosinophil count in Group II

Radiography on different postoperative days in Group I demonstrated that there was no reduction in the size of the tracheal lumen at the site of anastomosis in five of the six animals

In Group II radiography revealed a progressive reduction in the size of the tracheal lumen at the site of reconstruction in four animals and only slight reduction in one dog on the 45th postoperative day

At autopsy gross examination of the trachea at the site of anastomosis in Group I showed mild to moderate adhesions to the adjacent tissue and there was no reduction in the size of the tracheal lumen in five of the six dogs of this group

In animals of Group II dense adhesion between the site of reconstruction and adjacent tissue was observed The mesh was

fully incorporated at the site of reconstruction in five of the six animals One animal had shown anastomotic dehiscence Almost complete occlusion of the trachea by overgrowth of tissue was observed in four animals and slight reduction in the tracheal lumen in one animal

Histopathology at the site of anastomosis in Group I revealed complete healing of all the layers of the trachea by the 30th postoperative day

In Group II tracheal stenosis was associated with ingrowth of granulation tissue in four animals The mesh was infiltrated by fibrous tissue in five of the six animals Epithelium was seen lining the prosthesis on the 45th postoperative day