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HEALING FOLLOWING TEMPORARY TRACHEOSTOMIES IN DONKEYS

(With 2 Tables and 10 Figures)

By

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الالتئام بعد الفتح المؤقت للرغام في الحمير

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تم في هذا البحث اجراء عمليات فتح مؤقت للرغام في ٩ حمير طبيعية وذلك بتدخيل الأنابيب الخاصة بالرغام إلى تجويفه من خلال نافذة تم فتحها في الناحية البطنية له ، ولدراسة تأثير قطر أنبوبة الرغام على الالتئام أستخدم في هذا البحث ثلاثة أنابيب رغام كانت أقطارها الخارجية تساوي ١٠ ، ٢٠ ، ٢٦ مم . قسمت الحمير إلى ثلاثة مجموعات معتمدا على مدى تواجد أنبوبة الرغام داخل تجويفه ، ولقد كانت المدد ٧ ، ١٤ ، ٢١ يوم للمجموعة الأولى والثانية والثالثة على التوالي . في كل مجموعة درس الالتئام وتم تقييمه اكلينيكيًا ثم أعدمت الحيوانات الثلاثة بعد ١٠ ، ٢٠ ، ٢٠ يوم من ازالة أنبوبة الرغام وتم عمل الصفة التشريحية للرغام وذلك لتقييم الالتئام بالعين المجردة وأخذت عينات لتقييم الالتئام بها مجهريا . بينت المدلولات خلو الحيوانات جميعها من العدوى كذلك خلوها من أي أجسام غريبة تكون قد دخلت من نافذة الرغام وبعد ٧ إلى ١١ يوم بعد ازالة أنبوبة الرغام كانت الجروح الجلدية نظيفة ، جافة وملتأمة تماما . كذلك بينت الصفة التشريحية والتقييم الميكروسكوبي حدوث التئام تام للغشاء المخاطي المبطن للرغام بعد ٢٠ يوم ، ومن الصفة التشريحية أيضا اتضح حدوث ضيق في تجويف الرغام في مكان فتحه ، وكانت نسبة هذا الضيق تمثل ٢٠ و ٢٤ و ٢٢٪ من تجويف الرغام وذلك عند استخدام أنابيب رغام ذات قطر خارجي يساوي ٢٦ مم بينما انخفضت هذه النسبة إلى ٢-٤٪ عند استخدام أنابيب رغام ذات قطر خارجي يساوي ١٠ ، ٢٠ مم . اتضح من هذه الدراسة أن عمليات الفتح المؤقت للرغام في الحمير يترتب عليها أي مضاعفات خطيرة ولقد كان ضيق تجويف الرغام بعد العملية هي المضاعفة السائدة ولقد أمكن تقليل نسبة هذا الضيق باستخدام أنابيب رغام قطرها الخارجي صغير بالنسبة لقطر تجويف الرغام .

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INTRODUCTION

Traditional tracheostomies performed by the insertion of a cannulated tube through the tracheal wall into the tracheal lumen will be called temporary or tube tracheostomies (HEDLUND *et al.*, 1982). Historically, tracheostomies have been performed to facilitate passage of air or to evacuate secretions. In equine tracheostomy is indicated in operative procedures that jeopardize the patency of the patients airway or in disease conditions that obstruct ventilation proximal to the tracheostomy site. Respiratory obstruction associated with occlusive inflammation and edema following pharyngeal, laryngeal and tracheal surgeries may be alleviated by tracheostomies. Ventilation can be facilitated by tracheostomies in patients with upper respiratory tumors or trauma, laryngeal paralysis, infections, or coughing or swallowing difficulties (GABEL, 1969; MOORE, 1979 and JENNINGS, 1984).

JENNINGS (1984) stated that temporary tracheotomy incisions require a tracheostomy tube, either commercially available or improvised, to allow continued patency of the stoma created.

The major complication following temporary tracheostomy is tracheal stenosis (POLTER *et al.*, 1964 and DAVIES & MASON, 1968 and TATE *et al.*, 1981). The incidence of stenotic scarring or granuloma formation following temporary tracheostomy will increase in relation to the time the tracheostomy tube is left in place (TATE *et al.*, 1981 and JENNINGS, 1984). Such complications may rerequired a second surgical intervention to restore maximal patency of the trachea (KNESHT *et al.*, 1972; GORDON, 1973 and WITHROW *et al.*, 1978).

The indications for, techniques and management of tracheotomy described; however is little information to document duration and complication of tracheotomy in equine.

The present study was designed to examine and evaluate the clinical, gross and microscopic healing at intervals following tracheotomy where a Jackson's (10 mm od), Two Jackson's (20 mm od) Papes (26 mm od) and Peuchs (26 mm od) tracheotomy tubes (Fig. 1 & Table 1) were used for temporary intubation in donkey.

MATERIAL and METHODS

Nine clinically healthy donkeys (86-135 Kg. body weight) were used. The age of each donkey is shown in table 1. The animals were divided into three equal groups. On each donkey temporary tracheostomy was performed under the effect of Combelen (0.2 mg/Kg b.w. i.m.) and chloral hydrate (5 gm/50 Kg b.w. i.v.). In a dorsal recumbency postion, the area at the junction of the upper and middle third of the neck was

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clipped and prepared for aseptic surgery. On the ventral midline, a 8 cm incision was made through the skin and the superficial cutaneous colli muscle. Deep to this cutaneous muscle, the paired bellies of the sternothyrohyoideus muscle were visualized. The sternothyrohyoideus muscles were bluntly divided in the midline with scissors. The muscle was displaced laterally and the annular ligament between consecutive tracheal cartilages identified. The tracheal lumen was penetrated with a scalpel and the incision extended in either direction from the midline with scissors. The tracheal diameter measured through the tracheal incision using sterile scale. The length of the tracheal incision in each donkey is shown in table 1. When the tracheal incision was completed, an elliptical piece of cartilage was removed from the ring above and below the tracheal incision. A tracheostomy tube was inserted into the tracheal lumen and secured in place. In each donkey, the type and outer diameter (od) of the tube were shown in table 1. The tracheostomy site and tube were cleaned daily with a sterile saline solution. All animals were observed for tube fell out, plugging of the tube with mucus or purulent discharge, cough and subcutaneous emphysema during the entire period of intubation.

To determine the efficacy of Jackson's tube (10 mm od) as a tracheotomy tube in young donkeys when this tube was the only airway portal of the respiratory tract, packing of the nasal passages was performed 2 days following tracheostomy in donkeys No. 1 & 7. The donkeys were observed frequently for signs of respiratory stridor or dyspnea during the entire period of packing (3 days).

Following removal of the tube, the wound was left to heal by second intention and gently cleansed with saline once daily. Tetanus antitoxine was given at the time of surgery. Procaine penicillin (20,000 i.u./Kg. i.m.) was administered preoperatively and twice daily for 5 days. The appearance of the wound was recorded each day. During exercise the donkeys were observed daily for signs of respiratory stridor or dyspnea. In each animal, duration of intubation and period to autopsy are shown in table 2.

Following euthanasia, the trachea was removed and the appearance of the tracheotomy wound was recorded and photographed. Tracheal lumen was measured, and reduction in lumen area was calculated. The trachea was fixed in 10% neutral buffered formaline saline. It was dissected and a section of wall containing the tracheotomy site was routinely processed for Haematoxylin and Eosin staining.

RESULTST

Postoperative clinical evaluation:

Displacement of the tube not occurred in any animal during the entire period

of intubation. None of the two donkeys in which packing of the nasal passages was performed had signs of respiratory stidor or dyspnea. In donkey No. 1 the tube partially plugged with mucous during packing of the nasal passages, but the animal was breathing comfortably around and through the tube. The donkeys did not demonstrate coughing or have difficulty swallowing during this study. There was no purulent discharge from the tracheotomy skin wound at any time. A small amount of mucus accumulated around the tracheostoma for the first two days postextubation but was minimal after that time. No subcutaneous emphysema was noted during intubation or following removal of the tube in any of the donkeys. All skin wounds were clean and dry and could not be separated by gentle digital pressure at seven to eleven days following removal of the tube.

Gross appearances:

Results are shown in table 1 and in figures 1-6.

Histopathologic examination:

At 10 days, in all the stomas were closed with granulation tissue (Fig. 8). The granulation tissue was most mature adjacent to the tracheal cartilages. At 20 days, in all animals the granulation tissue was completely covered with pseudostratified columnar epithelium (Fig. 9). In donkey No. 5 the core of the polypoid mass was formed by inversion tissue and it was completely covered by pseudostratified squamous epithelium.

At 30 days, in all animals, the surface was covered by a pseudostratified columnar epithelium. The superficial lamina propria showed mild lymphocytic infiltration and the deeper portion exhibited marked fibrosis. Inversion of the peritracheal tissue was still evident, but appeared as mature granulation tissue (Fig. 10).

DISCUSSION

In this study tracheotomies performed by insertion of a 10 mm, 20 mm and 26 mm outside diameter tubes through ventral tracheal window into the tracheal lumen. The tubes kept in place for 7, 14 & 21 days. Most tracheostomy tubes are removed within 7 to 10 days (TURNER and McILWORTH, 1982 and PETER, 1984). Some obstructive lesions of the upper respiratory tract require a long-term temporary tracheostomy for resolution. Examples may include severe obstructive disease following trauma to the rostral nasal passage, neoplasia of the upper respiratory tract and laryngeal stenosis (CHERYL, 1982 and JENNINGS, 1984). Long-term temporary tracheostomy is interpreted as that required for two to four weeks (MOORE, 1977; BRYANT, 1978 and TURNER & McILWRAITH, 1982). Removal of an elliptical piece of the tracheal cartilage from

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the ring above and below the surgical site has been suggested if a longer-term temporary tracheostomy is required (O'CONNOR, 1965; BERGE and WESTHUSES, 1966 and JENNINGS, 1984).

This study shows that, healing was clinically excellent following tracheotomy where a window was created in the ventral aspect of the trachea with long-term duration of intubation. There were no clinically evident infections, and no foreign bodies were inhaled through the tracheostoma.

Pape's (26 mm od) and Peuch's (26 mm od) tracheotomy tubes have been used most extensively and successfully as a tracheotomy tubes in horses (RAKER, 1975 and PETER, 1984). In a study where 26 mm od tracheotomy tubes (Pape's and Peuch's) were kept in place for 14 at 21 days caused a 4% lumen area reduction (RAKER, 1970). In the present study when this tubes were used in donkey No. 3,4 & 8 cause 20%, 24% and 22% reduction of the lumen area. This is may be due to the presence of relatively large tracheal tuber for long period in the tracheal lumen which may cause pressure on the tracheal mucosa at the tracheotomy site. The pressure appeared to cause reduction in the tracheal lumen (BOJRAB and RENEGAR, 1981). The tracheotomy incision suggested by PETER (1984) was approximately one-fourth to one-third of the luminal diameter. In the present study the insertion of 26 od tube in the tracheal lumen required at least 26 mm incision (Table 1) i.e. it required incision approximately equal to the diameter of the trachea. This length of the tracheotomy wounds may cause invagination of peritracheal adipose and connective tissues into the stoma and this cause detrimental effect to the healing process. In the present study the reduction of the tracheal lumen area was 2-4% in donkey No. 1,2,5,6,7 & 9 when 10 mm od (Jackson's) or 20 mm od (2 Jackson's) were used. This may be due to the diameter of the tube was relatively small compared to the tracheal lumen (Table 2). Thus the tubes cause no pressure on the tracheal mucosa as well as the small length of the incision (Table 1) cause no detrimental effect on the healing process. In a previous study, on dogs, where a tracheal window was created and a large tracheotomy tube was used and kept in place for 14 days, an average reduction in the tracheal lumen at the stoma was 24.3% (range 5-57%) was found at autopsy 60 days posttracheotomy (GORDON, 1973 and BRYANT, 1978). This study agree with our findings in that tracheotomy tubes of large diameter predispose to stenosis. Retention of a tracheotomy tube for more than seven days cause a significant increase in stenosis in humans (WESTGATE and ROUX, 1970), and tracheotomy tubes of large diameter predispose to stenosis (ANDREWS and PEARSON, 1970). These findings suggest that minimal reduction in lumen area in this study is due to use of relatively small diameter metal tubes compared to that of the tracheal lumen.

On microscopical examination complete epithelization was present as early as 20 days following intubation. Invagination of peritracheal adipose and connective tissue

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into the stoma formed the core of the polypoid mass, which protruded into the tracheal lumen in donkey number five. No abnormalities of the cartilage rings were seen.

Most surgical texts contain a description of one or more methods tracheotomy in equine; however there are no previous reports of the incidence of complications associated with temporary tracheotomy in donkey or of the importance of the diameter of the tracheal tube in preventing or decrease tracheal stenosis.

The results of this study suggest that: 1- Longe-term tracheotomy in donkeys is a low-risk procedure as no animal developed life threatening complications 2- The tracheotomy tube should be selected at the time of placement based on the tracheal diameter. The tracheal diameter can be measured during surgery using sterile scale. 3- The tube must be relatively smaller in diameter as compared to that of the tracheal lumen. 4- Tube plugging may not be live threatening if the tube is small enough to allow ventilation around and through it. 5- 20-24% reduction in the tracheal lumen not cause difficulty in breathing at rest or during exercise.

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LEGENDS

- Fig. 1: A. Papes tracheotomy tube B. Peuchs tracheotomy tube C. Jackson tracheotomy tube.
- Fig. 2: External appearance of tracheotomy wound at autopsy. A (10 days postextubation). B (20 days postextubation). C (30 days postextubation).
- Fig. 3: Internal appearance of tracheotomy wound at autopsy in donkey No. 2 (The tube left for 7 days - euthanized 20 day postextubation).
- Fig. 4: Internal appearance of tracheotomy wound at autopsy in donkey No. 5 (The tube left in place for 14 days - euthanized 20 days postextubation).

- Fig. 5:** Cross section of trachea showing scar resulting from tracheotomy in donkeys where a 26 mm outer diameter tracheotomy tubes were used.
- Fig. 6:** Internal appearance of tracheotomy wound at autopsy in donkey No. 6 (The tube left in place for 14 days - euthanized 30 days postextubtion).
- Fig. 7:** Internal appearance of tracheotomy wound at autopsy in donkey No. 9 (The tube left in place for 21 days - euthanized 30 days postextubation).
- Fig. 8:** The stoma was closed with granulation tissue.
- Fig. 9:** The granulation tissue was completely covered with pseudostratified columnar epithelium.
- Fig. 10:** Inverted peritracheal tissue, appeared as mature granulation tissue.

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Table (1): The age, length of the tracheotomy incision and tracheotomy tubes in operated donkeys.

Group No.	Donkey No.	Age(years)	Length of the tracheotomy incision(cm)	Tracheotomy tubes	Outer diameter of the tracheal tube (cm)
I	1	1.5	10	Jackson's*	10
	2	2	10	Jackson's	10
	3	1	26	Pape's**	26
II	4	5	26	Feuch's***	26
	5	6	20	2 Jackson's	20
	6	4	20	2 Jackson's	20
III	7	1	20	2 Jackson's	20
	8	5	26	Pape's	26
	9	3	20	2 Jackson's*	20

* A double-tube silver Jackson's with obturator. J. Sklar Mfg. Co., Inc., L.I.C., N.Y.
2 Jackson's = 2 tubes were inserted in one tracheal stoma

** Pape's trachea tube, for temporary tracheotomy, adjustable, suitable for all size of animals.
Veterinary Instruments, H. Hauptner Solingen.

*** Feuch's trachea tube 4 cm. H. Hauptner Solingen.

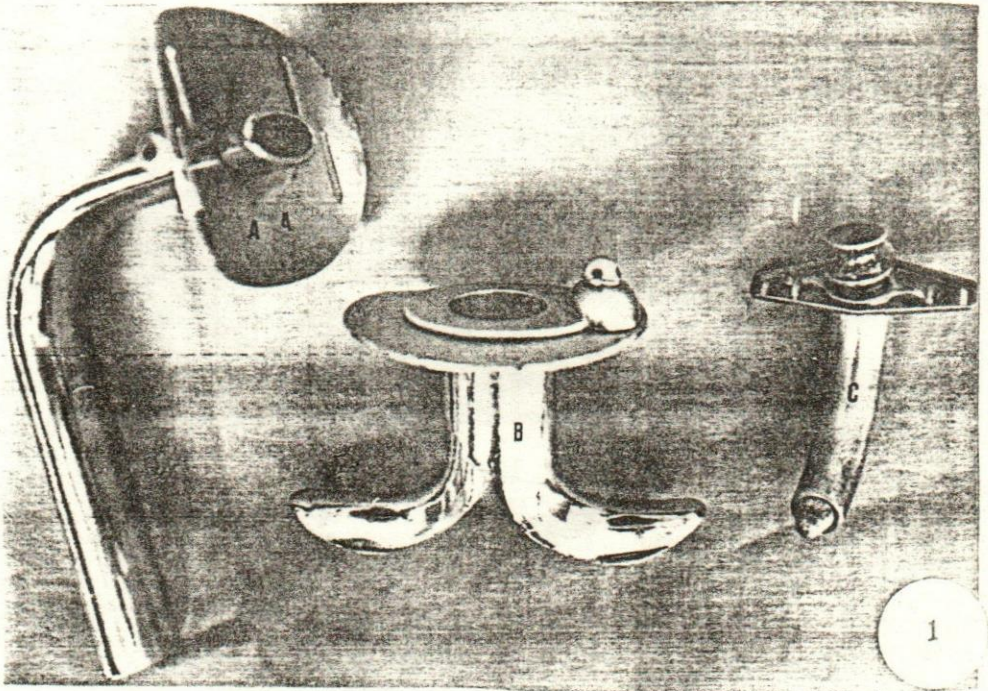
Table (2): Summary of treatment and results of long-term tracheotomy in the donkey.

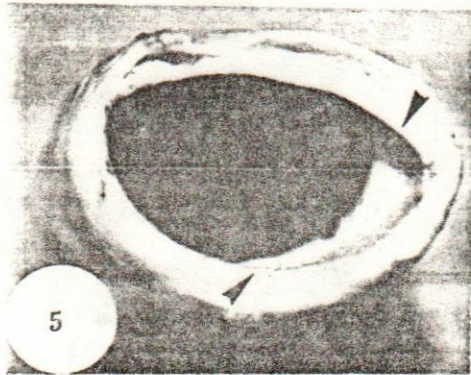
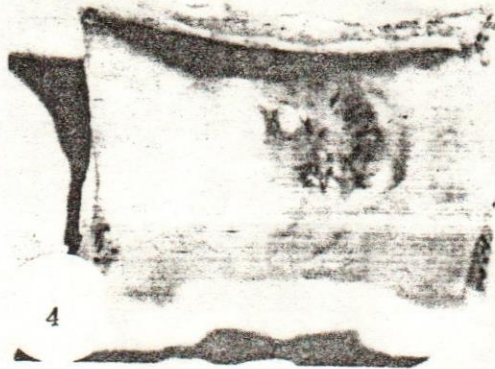
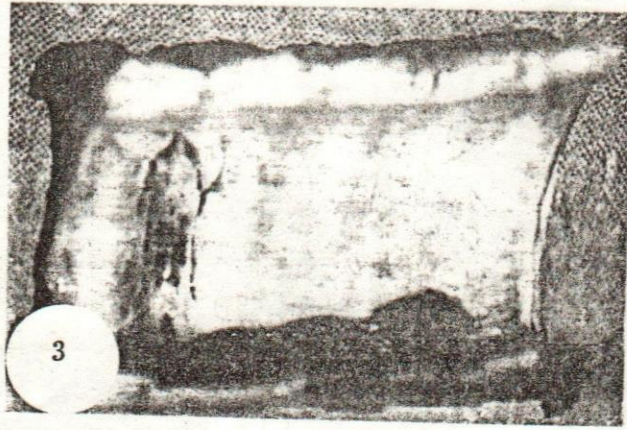
Group No.	Donkey No.	Duration of Intubation	Wound skin closure*	Period for autopsy**	Diameter of tracheal lumen	Growth appearance	% of reduction in tracheal lumen area
I	1	7	7	10	30 x 18	The rings lying in normal position on either side of the tracheotomy wound and the stoma filled with hemorrhagic tissue. Blood vessels visible in adjacent mucosa.	2
	2	7	10	20	28 x 17	Tracheal rings in normal position. On exterior surface small tissue masses visible at tracheotomy wound. On the internal surface was covered by epithelium except for 2 ml hemorrhagic mucosal ridge (Fig. 3)	2
	3	7	7	30	32 x 18	Trachea appears normal except for firm mucosal ridge at tracheotomy site.	20
II	4	14	9	10	32 x 20	Tracheal rings in normal position. Little subcutaneous swelling. The tracheotomy wound filled with granulation tissue. On the exterior surface the granulation tissue was limited grossly to a small area (Fig. 2, a). On the internal surface firm tissue mass visible at tracheotomy site.	24
	5	14	9	20	30 x 21	Tracheal rings in normal position. Tracheal epithelium cover 60% of the tracheotomy site, with 7 mm zone of hemorrhage. A polypoid mass extended into the tracheal lumen. It was completely covered by epithelium (Fig. 4). On exterior surface, small ridge visible at tracheotomy site (Fig. 2, b).	4
	6	14	10	30	31 x 19	Trachea appears normal. On exterior surface well healed wound difficult to see. On internal surface the tracheotomy site was covered completely by epithelium (Fig. 6).	-
III	7	21	8	10	32x21	The gross findings were similar to those described for donkey No. 4.	3
	8	21	11	20	30x20	Trachea appears normal except for 7mm mucosal ridge at tracheotomy site (Fig. 5).	22
	9	21	10	30	30 x 21	Well healed wound on exterior of the trachea (Fig. 2, c). 1mm mucosal ridge along the healed wound on the epithelium (Fig. 7).	3

* Skin sound clean, dry, covered by scab and edges could not be separated by gentle lateral pressure.

** Period from removal of the tracheal tube to autopsy

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