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EXPERIMENTAL TRACHEAL RESECTION AND ANASTOMOSIS IN DONKEYS

(With 5 Fig. & One Diagram)

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الاستئصال التجريبي الجزئي للرغام وتوصيله في الحمير

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أجرى هذا البحث التجريبي في جراحة الرغام العنقى على عدد (١٢) من الحمير السليمة من الناحية الصحية . قسمت الحيوانات إلى اربعة مجموعات متساوية فى العدد (كل واحد تضم ثلاثة حمير) . تم إستئصال عدد ثلاثة وخمسه وسبعة وتسعة حلقات من الرغام من المجموعه الأولى والثانيه والثالثه والرابعه على التوالي . وتمت الخياطه فى كل الحيوانات بطريقه الفرز المثبتة (Stay Suture) باستخدام خيط الحرير رقم (١) بالاضافه الى مجموعه من الفرز المتقطع باستخدام خيط أمعاء القط رقم (٣ / صفر) ولقد تم متابعة الحيوانات اكلينيكيًا وتم أيضاً أخذ صور بأشعة إكس لكل الحيوانات أسبوعياً لمدة ثلاثة أشهر . وتم عمل الصفه التشريحيه للرغام وذلك لتقييم الالتئام بالعين المجرده واخذت عينات لتقييم الالتئام بها مجهرياً .
إتضح من هذه الدراسه أن الالتئام يتم بصورة مرضيه بدون مضاعفات بعد إستئصال ثلاثة أو خمس حلقات من الرغام بينما ضيق تجويف الرغام فى مكان التوصيل هو العيب الوحيد بعد إستئصال سبعة أو تسعة حلقات .

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SUMMARY

A surgical technique for resection of a segment of the trachea followed by end-to-end anastomosis was developed on 12 clinically normal donkey divided into 4 equal groups. The numbers of the removed tracheal rings were 3, 5, 7 and 9 rings from group 1, 2, 3 and 4 respectively. The tracheal anastomosis was conducted using 4 stay silk No. 1 sutures and interannular interrupted chromic catgut 3/0, 0.5 cm apart. The healing process was evaluated on the basis of clinical results, postmortem findings and microscopical results. The trachea healed without complications in all donkeys in which 3 and 5 tracheal ring were removed. While tracheal stenosis was the only complication in all donkeys in which 7 and 9 tracheal rings were removed.

Keywords: Tracheal resection, anastomosis, donkeys.

INTRODUCTION

Resection and end-to-end anastomosis of the trachea is a practical procedure for correction of various form of tracheal stenosis. Tracheal stenosis may be caused by foreign bodies (BEITZEL and BRINKER, 1956 and BROWN and LUMB, 1958), neoplasms (WITHROW, HOLMBERG and DOIGE, 1978 and BRODEY, O'BRIEN and BERG, 1969), torsion of the trachea (CORLEY, 1965), vascular anomalies (LINTON, 1956), collapsed tracheal rings (SCHILLER, HELPER and SMALL, 1964 and LEONARD, 1971), stricture following tracheostomy (POTTER, BROWN and CARTER, 1964 and DAVIES and MASON, 1968) and granulomas resulting from intubation with cuffed endotracheal tubes (BRYANT, TRINKEL and DUBILIER, 1971).

Tracheal collapse syndrome and stenotic trachea successfully repaired (CANTRELL and FOLSE, 1961; GORDON, 1973 and BOJRAB and NAFE, 1976).

Massive tracheal resection (19 tracheal rings) and anastomosis in dogs was performed by MISK, *et al.*, (1986). In the available literature, there is no reports of successful resection and anastomosis of the trachea in horses except that of TATE, KOCH, SEMBRAT and BOLES (1981), in which not more than 3 tracheal rings were removed.

The aim of the present work is to evaluate the techniques for anastomosis of the trachea in the dog when applied to the donkey as well as to estimate the number of the tracheal rings that can be resected without complications.

MATERIAL AND METHODS

The present work was carried out on 12 clinically healthy donkeys (5-6 years old and 130-150 kg body weight). The experimental animals were divided into 4 equal groups. The numbers of the removed tracheal rings were 3, 5, 7 and 9 rings from group 1, 2, 3 and 4 respectively. All donkeys were given deep narcosis in a dose of 10 gm/100 kg body weight chloral hydrate i.v. in a 10% solution (HALL, 1974). After induction of narcosis, the donkeys were positioned in dorsal recumbency, the hair was clipped in the area of the mandible to the thoracic inlet, and the skin was prepared for aseptic surgery. A 30-cm ventral midline cervical incision was made over the tracheal cartilages extended from the cricoid cartilage to the thoracic inlet. The sternothyroid and sternohyoid muscles were divided, exposing the trachea and surrounding fascia. Mobilization of the trachea consisted of dissecting the trachea free from its fascial bed and ligating and transecting blood vessels as necessary (CANTRELL, et al., 1961 and BOJRAB, et al., 1976).

Four stands of No.1 monofilament silk were applied at 90-degree intervals at the second cartilages proximal and distal to those to be removed. The four strands of the stay stitches were temporarily fixed by artery ends of the tracheal segment, through the annular ligament adjacent to the tracheal cartilage of the segment which will be removed. This created a circumferential flaps on each free ends of the divided trachea to apply the interannular sutures. About four simple interannular interrupted stitches (chromic catgut No 3/0) were applied between the four stay stitches (0.5 cm apart) in alternative manner through the upper and lower connective tissue collar and the tracheal mucosa. The four interannular interrupted stitches were placed without knotting to facilitate their application. The stay stitches were tied firstly then the interannular interrupted ones (Diagram 1). The cervical wound was coaptated as usual. The martingale-like apparatus was applied before recovery from anaesthesia. The donkeys wore the apparatus continuously for 3 weeks after surgery to maintain the head at a 90-degree angle to the neck (Fig.1). Antibiotics were given systemically for 5 days.

The animals were clinically investigated from the day of operation till the time of euthanasia (3 months postoperative) or when death supervene. Local changes at the seat of operation and the process of healing of the skin wound were also observed for presence of oedema, abscess and fistulation. The animals were subjected to radiographical examination every week for

detection of the degree of tracheal stenosis and any tracheal dehiscence. Postmortem examination were performed at the time of euthanasia or directly after death by exposure of the trachea through a longitudinal incision at the ventral aspect of the neck. In addition to tissue specimens were obtained from the site of the anastomosis and its neighbouring tissues for histopathological examination.

RESULTS

Clinical picture: All the donkeys of this work were survived till the end of the experiment except those of group 4 (9 tracheal rings resection) were died around the 30th day postoperatively ± 5 days. The swallowing process was somewhat difficult at the first 5 days postoperatively in all groups. In group 4, this period prolonged till the day of death. The respiration was somewhat shallow and rapid at the first 5 days in groups 1, 2 and 3 where 3, 5 and 7 tracheal rings were resected respectively. In group 4, the respiratory distress was continued till the day of death. Whistling sound noticed in group 3 (7 tracheal rings resection) during exercise while in group 4, this sound was noticed in rest 15 days postoperatively. In exercises, the animals of this group exhibited sever respiratory distress (rapid and shallow respiration with whistling sound) ended with severe exhaustion and exercise intolerance.

Slight inflammatory swelling at the ventral aspect of the neck was observed at the first few days after operation. The swelling completely subsided at the beginning of the second week. The healing of the skin wound was accomplished by first intention within ten days postoperatively when skin sutures were removed.

The interpretation of different radiographs were not reveal any disruption in the continuity of the trachea in all animals from the time of operation till the day of euthanasia. At the line of the tracheal anastomosis, a radiopaque soft tissue density mass all around the line of anastomosis were seen resulting in tracheal stenosis. This stenosis increased gradually in ascending manner with the increase in the number of tracheal rings resection (Fig. 2).

Post-mortem examination: Adhesions between the operated part of the trachea and the surrounding structures were not observed at the first two groups while at the last two groups slight to moderate adhesions were observed. Haematomas,

fistulae and abscesses were not detected at the seat of the operation in all animals. The postmortem picture from outside showed that the suture material in all cases of the whole groups appeared imbedded inside tissues (Fig. 3). From inside the interannular suture materials were buried inside the tissues of all cases while one of the stay stitches (which applied around the tracheal muscle) appeared clear and hanged in a form of a loop into the lumen of the trachea (Fig. 4). The tracheal wall at the seat of anastomosis appeared thicker than original wall in cross section. The diameter of the trachea at the seat of anastomosis was approximately 90% of the normal in all donkeys of groups 1 and 2, while in groups 3 and 4 it was approximately 25% and 10% of the normal trachea respectively (Fig. 4).

Histopathological finding:

On histopathological examination the samples taken after 30 ± 5 days (group 4) post resection showed epithelial and proliferative changes for covering the new fusion. The fusion consisted of scar tissue (Fig. 5b, c). After 3 months (groups 1 to 3) the epithelial proliferative changes increased and was well expressed (Fig. 5A). In addition mature scar could be seen around the remanent of the suture material (Fig. 5d).

DISCUSSION

Tracheal resection with end-to-end anastomosis was indicated for many congenital and aquired surgical affections of the trachea. As the trachea consists of cervical and thoracic parts, the former appeared to be the most accessible part for surgical interferences (RAMAKRISHNA and BOSE, 1980, TATE, et al., 1981; MISK, et al., 1986; ABDEL-HAMID, 1990 and AHMED, 1990).

Successful end-to-end anastomosis of the trachea has been found to depends on adequate mobilization of the trachea (CANTRELL and FOLSE, 1961; GRILLO, 1970 and NAEF, 1973), avoiding excessive tension on the anastomosis (FERGUSON, et al., 1950; SOM and KLEIN, 1958 and GRILLO, 1973) and preventing granuloma or fibrous webs at the surgical site (TATE, et al., 1981). To achieve the above mentioned conditions in the present study, mobilization of the trachea from its fascial bed, application of the stay suture using nonabsorbable suture material, restrict head movement and maintain the neck in flexed position by martingle-like apparatus were affirmed.

No complications were encountered after mobilizing the trachea from its fascial bed, an observation which coincides

with that stated by GORDON (1973) in dogs, HORNEY (1975) in CALVES and SCOTT (1978) and Tate, et al. (1981) in horse. As in the horse, the donkey appears to have an extensive collateral vascular plexus. The proximal arterial supply arises from the inferior thyroid artery and distally it is supplied from the bronchial arteries. In man, interruption of the segmental arterial supply leads to necrosis of the trachea and failure of reconstructive procedures (GASSANIGO, et al., 1971 and GRILLO, 1973).

In horses, TATE, et al., (1981) used another suture pattern, in which three free edges of the mucosa was folded back and fixed to the adventitia thus opposing the two mucosal surfaces. At the same time the anastomosis included only the whole thickness of the adventitia. This technique could not be used in donkeys because the adventitia of the trachea not thick enough to sustation sutures and to hold the submucosa and mucosa everted while completing the anastomosis.

This study shows that, healing was clinically excellent following 3 and 5 tracheal rings resection and anastomosis where the stay suture using silk No 1 and chromic catgut No 3/0 at the interannular ligament including the tracheal mucosa. The use of non-absorbable suture material in case of tracheal anastomosis of donkeys is obligatory because the trachea is not elastic enough as in case of dog to reduce tension at the suture line to avoid dehiscence of the tracheal anastomosis. With the use of chromic catgut, there were no granulomas formation in all cases. This observation was supported by the observation of MISK, et al., (1986) who stated that the chromic catgut is found to be suitable material required for obtaining the relative maximum epithelial regeneration without severe tissue reaction.

The observation of the presence of a stay suture-which applied in the tracheal muscle-hanged into the tracheal lumen, can be explained by the presence of a high tension at the suture line and consequently rupture of the tracheal muscle was occurred.

As a conclusion, the result of this work suggest that tracheal resection and anastomosis in donkeys is a low risk procedures when the resection not more than 5 tracheal rings.

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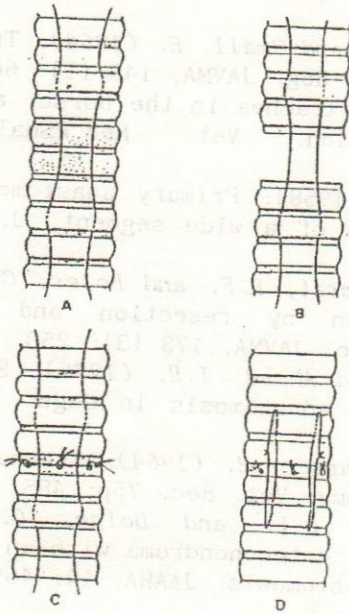


Diagram (1): showing methods of resections and suture techniques (after Misk, et al., 1986)

- A. Application of stay stitches before resection,
- B. Resection of the tracheal rings,
- C. Application and knotting of interannular interrupted stitches,
- D. Knotting of the stay stitches.

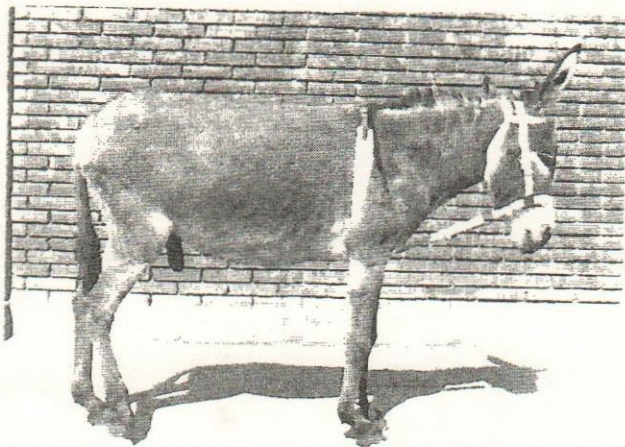


Fig. (1)

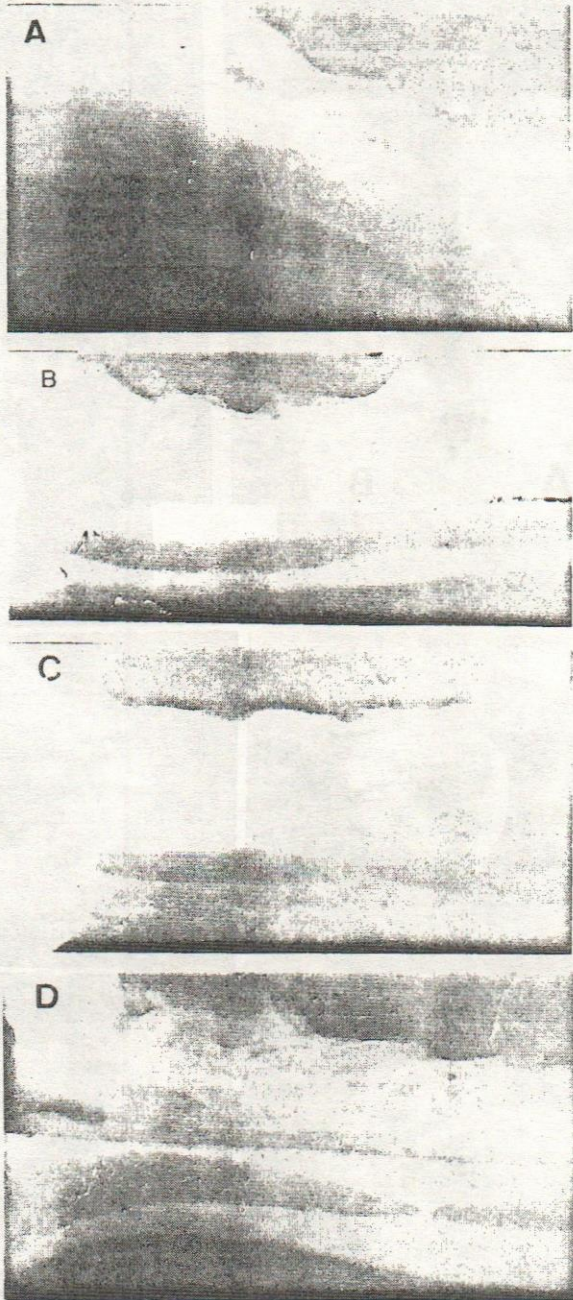


Fig. (2)

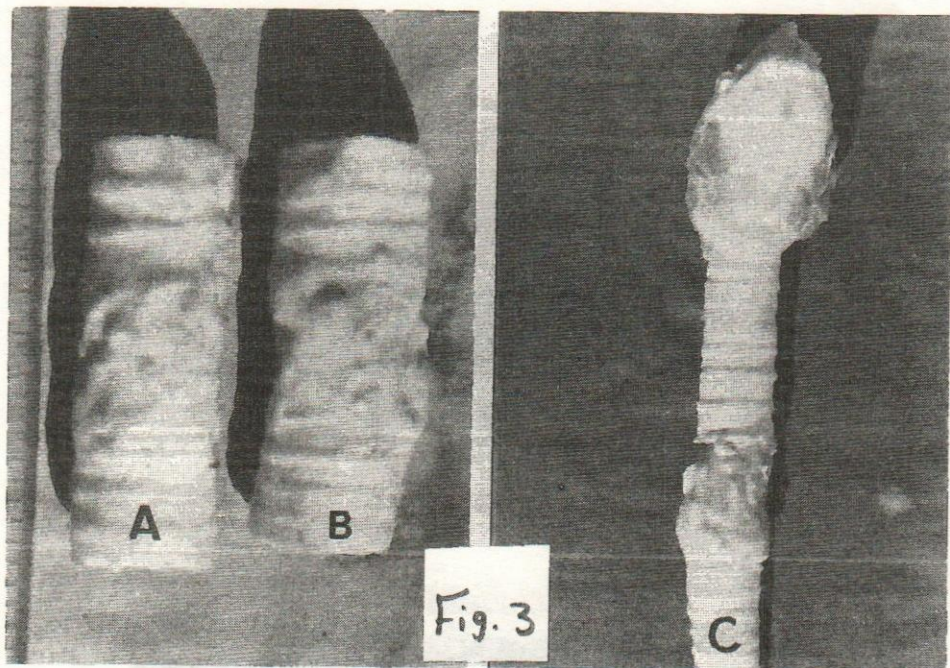


Fig. 3

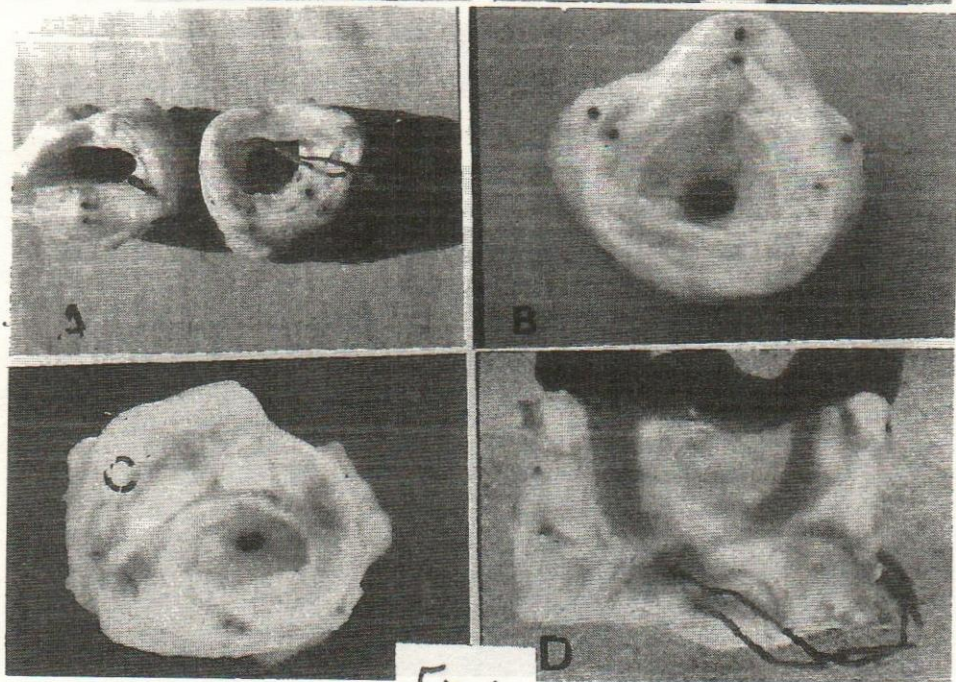


Fig. 4

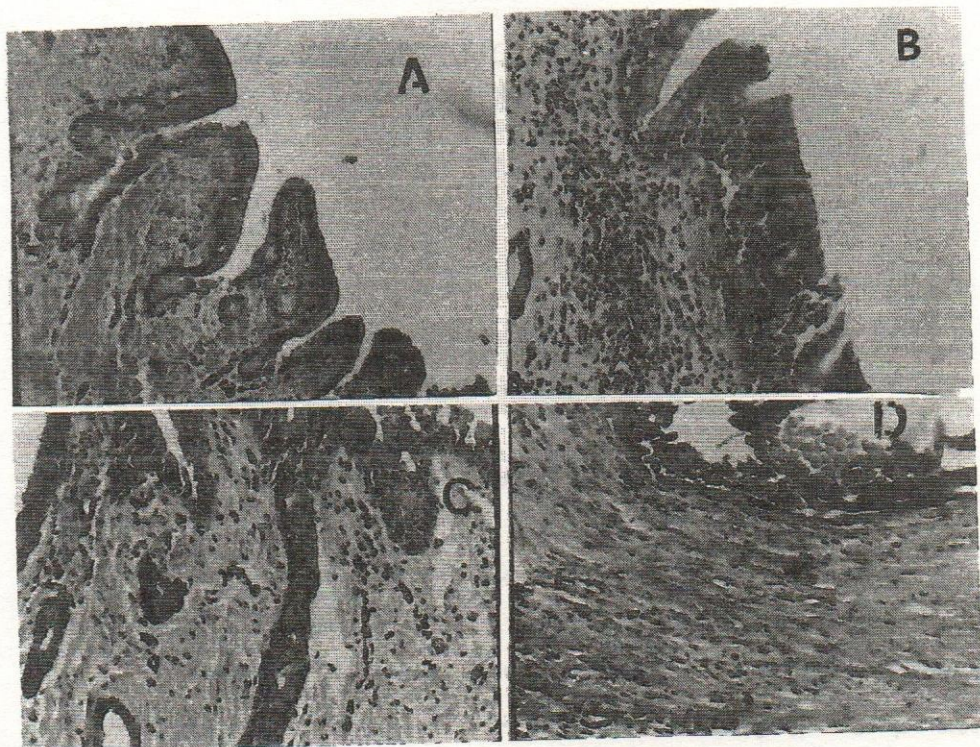


Fig. 5