Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Experimental replacement of esophagus with a short segment of trachea

Azizollah Abbasidezfouli, MD,[a] *Damoon Ansari, DVM,*[b] *Kambiz Sheikhy, MD,*[b,*] *Mohammad Abarkar, DVM,*[c] *Farahnaz Sadeghbeigi, MD,*[a] *Sepehr Abbasidezfouli, MD,*[d] *and Davood Sharifi, DVM*[e]

[a] *Lung Transplantation Research Center, National Research Institute of Tuberculosis and Lung Disease (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran*

[b] *Tracheal Diseases Research Center, National Research Institute of Tuberculosis and Lung Disease (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran*

[c] *Faculty of Veterinary Medicine, Karaj branch of Islamic Azad University, Karaj, Iran*

[d] *Telemedicine Research Center, National Research Institute of Tuberculosis and Lung Disease (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran*

[e] *Department of Clinical Science, Surgery and Radiology Section, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran*

ARTICLE INFO

Article history:
Received 20 July 2015
Received in revised form
25 September 2015
Accepted 8 October 2015
Available online 23 October 2015

Keywords:
Esophagus
Trachea
Resection
Anastomosis
Replacement

ABSTRACT

Background: Segmental resection of esophagus with primary anastomosis is prohibited because of the risk of dehiscence. We previously have shown that replacement of a segment of cervical esophagus with a tracheal segment of the same length could successfully be performed in a canine model. In this study, we sought to assess the feasibility of replacement of the esophageal defect with a shorter segment of trachea.

Methods: In five mongrel dogs weighting 20–30 kg, under general anesthesia and after a cervical incision, 8 cm of the cervical esophagus was resected and replaced by a 4-cm segment of the adjacent trachea. The animals were evaluated clinically for signs and symptoms of stenosis and dehiscence and then euthanized after 2 mo of follow-up.

Results: All dogs recovered from surgery and started regular diet on the seventh postoperative day. No clinical or endoscopic sign of stenosis or voice change was seen. Squamous metaplasia and atrophy of mucosal glands and cartilage were detected in the histopathologic examination of the replaced segments.

Conclusions: Replacement of a cervical esophageal defect with a shorter segment of trachea can be performed successfully in dogs. This procedure can be potentially used for the treatment of cervical esophageal lesions in humans.

* *Corresponding author*. Tracheal Diseases Research Center, Shahid Beheshti University of Medical Sciences, Masih Daneshvari Hospital, Shahid Bahonar Ave, Darabad, Tehran 19558-41452, Iran. Tel./fax: +98 21 26105387.
E-mail address: ksheikhy@sbmu.ac.ir (K. Sheikhy).

0022-4804/$ – see front matter
http://dx.doi.org/10.1016/j.jss.2015.10.017

1. Introduction

In routine surgical practice, most esophageal lesions are malignant and usually are treated by total resection of esophagus and replacement with colon, stomach, or other composite flaps [1–3]. In some situations, especially benign esophageal lesions or rarely malignant disease, surgeon may consider segmental resection of the esophagus and reanastomose the two remaining ends [4]. Special anatomic structure of esophagus prohibits safe segmental resection of esophageal lesions and primary anastomosis of the ends. Immediately after segmental resection of esophageal lesion, the two intact ends retract in a way that a considerable traction force is required to bring them together that will result in high tension in anastomosis suture line. Additionally, owing to the absence of serous layer in esophagus and continuous movement of this organ at the time of swallowing, resection and primary anastomosis of esophagus has a high risk of dehiscence and is usually avoided. Some surgeons use complex procedures for transposition of these resected parts of esophagus such as free jejunal flap or tubular skin flaps but owing to the complexity of these surgeries and their side effects, neither the patients nor the surgeons have been satisfied. In addition, usage of artificial prosthetic segment has not been desirable. On the other hand, trachea is a cartilaginous tissue, which makes it resistant to high anastomotic tension. Therefore, replacement of a segment of esophagus with a segment of normal and healthy trachea may be very useful in treating lesions such as stricture or benign tumors and may avoid more complicated surgeries as mentioned above.

We have already shown that it is possible to replace a segment of cervical esophagus with the same length of trachea in an experimental study in dogs, in which the animals were able to tolerate normal diet after surgery [5]. Performing the same surgery in humans may be difficult; however, as human's neck is shorter in comparison with dogs. Therefore, this operation would be more feasible if we could use a smaller section of trachea for esophageal substitution. Therefore, in this second phase of study, we used a 4-cm tracheal segment to replace an 8-cm esophageal defect. We believed that this type of replacement would be feasible as esophagus and trachea have the same embryonic origin, that is, trachea is separated from foregut endoderm as a bulge, and the septum between trachea and esophagus is developed gradually.

Tracheal resection and anastomosis was developed after experimental works of Grillo and Cooper [6–9] which was followed by extensive clinical practice and good results [10]. Since Grillo, many thoracic surgeons have been able to achieve the same results [11–13]. We also have large volumes of clinical experience with tracheal resection and anastomosis with good results [14].

2. Materials and method

2.1. *Animal preparation and anesthesia*

Five mongrel dogs, weighting 20–30 kg with the mean age of 2 y, underwent esophageal replacement surgery. Routine clinical examinations including chest x-ray and laboratory tests for parasitic infection were done. They were fasted for 12 h before surgery and then premedicated with Acepromazin (0.01 mg/kg) and Ketamin (10 mg/kg) intramuscularly, followed by subcutaneous injection of Atropine (0.03 mg/kg after 20 min). Induction of anesthesia was performed using Ketamin (5.5 mg/kg) and Diazepam (0.27 mg/kg). General anesthesia was maintained by administration of isoflurane through an orotracheal tube. Based on our large experience in tracheal surgery, ventilation of the animals was followed by tracheal intubation through field of surgery after resection of tracheal segment and was later reestablished orotrachealy after tracheal anastomosis was done (Fig. 1).

2.2. *Surgical procedure*

Surgical approach was through an 8–10 cm midline cervical and longitudinal incision, beginning over the cricoid cartilage extending downward. After incising the skin, deep cervical fascia was cut in midline, strap muscles were split and retracted laterally, and anterior surface of trachea was released downwardly from cricoid to the level of lower trachea (Fig. 2A). Starting at fourth ring, a 4 cm length of trachea was separated while preserving the lateral and posterior fibroareolar attachments (Fig. 2B). An 8-cm esophageal segment was resected; starting 2 cm above and ending 2 cm below the level of tracheal divisions. During resection of esophagus, we tried to avoid damaging the fibroareolar tissue around the separated tracheal segment (Fig. 2C). Afterward, the separated tracheal segment was shifted to the left while keeping it attached to posterior and lateral soft tissues and vessels and was anastomosed to the esophagus as an interposed graft using running 2-0 prolene suture (Fig. 2D). The remaining two ends of the residual trachea were anastomosed together using the same technique. Two supportive sutures were placed in lateral sides of tracheal ends to pull them closer for easier anastomosis (Fig. 2E and F). At the end-strap muscles, platysma and skin were closed. Neither drain nor nasogastric tube was used postoperatively.

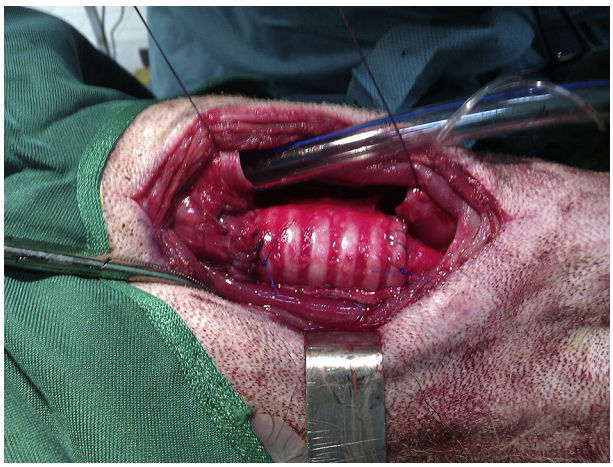

Fig. 1 – Endotracheal intubation after resection of tracheal segment through surgical field. (Color version of figure is available online.)